Deregulation of JAK2 signaling underlies primary cutaneous CD8+ aggressive epidermotropic cytotoxic T-cell lymphoma

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Supplementary methods.

Sequencing and data processing

Tumor (germline-unpaired) DNA and RNA samples were subjected to Illumina next-generation sequencing. DNA and RNA were sequenced by the Beijing Genomics Institute (BGI). For whole-genome sequencing, DNA libraries were prepared using TruSeq Nano DNA HT sample prep kit (Illumina), which involves DNA fragmentation by Covaris sonication, end-repair, A-tailing, adapter ligation, and fragment enrichment. Purified DNA fragments were subjected to paired-end sequencing (2 × 150 bp) on the Illumina HiSeq X-Ten platform. For RNA sequencing, total RNA was depleted from rRNA using Ribo-Zero Magnetic kit (Epicentre Biotechnologies, Madison, WI), fragmented, and followed by first-strand cDNA synthesis, second-strand cDNA synthesis (with dUTP instead of dTTP), end repair, A-tailing, adapter ligation, uracil-N-glycosylase treatment, and cDNA library enrichment. Purified cDNA libraries were subjected to paired-end sequencing (2 × 100 bp) on the Illumina HiSeq 4000 platform. DNA raw reads were processed with an in-house pipeline that included FastQC (v0.11.2), SeqTK (v1.0-r63), Cutadapt (v1.10), Sickle (v1.33), and aligned to human reference genome GRCh38 using BWA-mem (v0.7.10) (Table S2). RNA raw reads were processed with an in-house pipeline that included FastQC (v0.10.1), Cutadapt (v1.5), Sickle (v1.33), and aligned to human reference genome GRCh38 using GSNAP. WGS and RNA-seq datasets have been deposited in the European Genome-Phenome Archive (EGA) under study number EGAS00001004332.

DNA sequencing analyses

Detection of structural genomic variants (SV) was performed using Breakdancer-max (v1.4.4) and Delly (v0.6.7). Events detected in a healthy control (PBMC) processed with the same pipeline were regarded as mapping artefacts and filtered out accordingly. Rearranged genes implicated in cancer were identified using the Network of Cancer Genes 6.0 (NGC 6.0)[1] and literature search. Copy number alterations (CNAs) were identified with Control-FREEC (v8.7)[2] and GISTIC2.0[3] (Figure S2, Table S3). Non-cancer structural variants were identified using the Database of Genomic Variants[4] and filtered out accordingly. SV and CNAs were visually verified/curated using the Integrative Genomic Viewer (IGV, v2.3.78)[5] (Figure S3, Table S4-S5). GATK (v3.5) was used to detect deleterious indels/SNVs (Table S6). Indels/SNVs were investigated in exonic sequences of 1461 genes taking part in cellular processes/pathways previously identified as mutated in CTCL[6] (Table S7). Variant allele frequency of ≥0.1 and ≤0.9 and variant read coverage of ≥2 were applied. Non-cancer indels/SNVs were eliminated by filtering out polymorphisms in dbSNP, variants with >5% minor allele frequency in ExAC and variants detected in exomes of an in-house cohort formed by eleven healthy volunteers. Indels/SNVs predicted as benign/tolerated (SIFT and PolyPhen-2) and not flagged on COSMIC/ClinVar were excluded. Indels/SNVs predicted as deleterious and/or flagged as pathogenic on COSMIC/ClinVar were further investigated on Varsome and literature.

RNA sequencing analyses

EdgeR was used to apply TMM normalization on raw data. Limma-Voom was used to perform differential expression analysis. pcAECyTCL samples were compared to a control group formed by skin-resident CCR8+/CD8+ T cells.[7] RNA-seq data of CCR8+/CD8+ T cell controls were downloaded from SRA (https://www.ncbi.nlm.nih.gov/sra; ERP105873). Genes with FDR <0.01 were considered differentially expressed (DE) (Table S8). Fusion transcripts were investigated in six pcAECyTCL samples

with available RNA-seq data using FusionCatcher (v0.99.6a) and Star Fusion (v0.8.0). Fusion transcript calls were manually verified/curated using IGV (Table S9). Gene set enrichment analysis (GSEA, v2.2.4)[8] was run using gene sets from the Molecular Signatures Database (MSigDB). FDR *q* value threshold of ≤0.25, recommended by the developer, was used. Gene ontology annotation of rearranged genes was performed using Panther (v12.1).[9]

Sanger sequencing

Select rearrangements (i.e. *JAK2*, *MYC*, *RB1*, *SH2B3*), interstitial deletions (i.e. *SH2B3*) and SNVs (i.e. *JAK2*, *JAK3*, *STAT3*, *STAT5B*) were validated by Sanger sequencing (Figure 2/5, Figure S4-S6). Target sequences were amplified by PCR, run on a 1% agarose gel, column-purified and sequenced on the ABI3730xl platform (Applied Biosystems). Analysis of Sanger chromatograms was performed with Chromas software (Technelysium Ltd.).

Droplet digital PCR

Select CNAs (i.e. *CDKN2A*, *SH2B3*) were validated by droplet digital PCR (ddPCR) using QX200 ddPCR system (Bio-Rad) following the manufacturer's instructions (Figure 3, Figure S7). Genomic DNA (20-40 ng) was mixed with a frequent-cutting restriction enzyme, ddPCR supermix and probes against the target/reference genes (FAM/HEX-labeled, respectively). The reaction mix was partitioned into 20.000 nanodroplets and PCR-amplified. FAM/HEX fluorescence was measured with Bio-Rad QX200 droplet reader. Copy number values were determined using Bio-Rad Quantasoft software v1.7.4.

Fluorescent *in situ* hybridization

Break-apart fluorescent *in situ* hybridization (FISH) for *JAK2* was performed on formalin-fixed paraffin embedded (FFPE) tumor tissue using BAC probes as previously described.[10] BAC clones were purchased from BACPAC resources (https://bacpacresources.org/) at Children's Hospital Oakland (CHORI). Identity of isolated BAC probes was verified by FISH on metaphase controls and Sanger sequencing. Probe RP11-1151G4 (telomeric/5') and probes RP11-140C18/RP11-635N21 (centromeric/3') were used to detect DNA breaks at JAK2 (Figure S8, Table S10).

Methylation specific melting curve analysis

Methylation specific melting curve analysis (MS-MCA) was performed as previously described[11] on bisulfite-converted genomic DNA using primers directed at CpG islands within the promoter and gene body of *SH2B3* (Figure S9). Bisulfite converted CpGenome Universal Methylated DNA (Chemicon, Hampshire, United Kingdom) and unmethylated male DNA were used as positive and negative controls, respectively.

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Supplementary Table S1. Clinical information of patients included in the study.

Patient	Sex	Age	Skin	Cutaneous involvement	Stage at diagnosis	Extracutaneous involvement	Outcome	Follow-up (months)	Tumor cell % (biopsy)
AEC1	M	63	Patches and plaques	Generalized	T3N0M0	No	DOD	24	> 80%
AEC2	F	70	Tumours	Localized	T2N1M0	Yes	DOD	13	> 70%
AEC3	M	29	Patches and plaques	Generalized	T3N0M0	No	DOD	9	> 70%
AEC4	M	58	Ulcerated patches, plaques and tumours	Generalized	T3N1M0	Yes	DOD	24	> 70%
AEC5	F	60	Plaques and tumours	Localized	T2N0M0	No	DOD	6	> 70%
AEC6	M	56	Patches and plaques	Generalized	T3N1M0	No	DOD	9	> 70%
AEC7	M	87	Patches, plaques and tumours	Generalized	T3N0M0	No	DUC	10	> 80%
AEC8	F	73	Tumours	Localized	T1N0M0	No	AWD	4	> 80%
AEC9	M	72	Patches and plaques	Generalized	T3N0M0	No	DOD	10	> 70%
AEC10	M	27	Patches and plaques	Generalized	T3N0M0	Yes	DOD	7	> 70%
AEC11	M	62	Plaques and tumours	Generalized	T3N1M0	Yes	DOD	2	> 70%
AEC12	F	78	Patches and plaques	Generalized	T3N0M0	No	DOD	1	> 70%

AWD, alive with disease; DOD, died of disease; DUC, died of unrelated cause. Except for AEC11, patients analyzed in this study were also included in the following study: Fanoni et al. 2018. Genes, chromosomes & cancer, 57: 622–629.

Supplementary Table S2. Mapping and Coverage metrics of samples subjected to WGS.

Sample	Number of paired reads before QC	Number of paired reads after QC	% of reads mapped	Mean depth of coverage (X)
AEC1	443571958	441141759	99.89	36.78
AEC2	569890577	566526440	99.88	47.11
AEC3	625420910	611619361	99.56	51.19
AEC4	604420216	600507551	99.86	48.59
AEC5	595651605	591899885	99.87	48.24
AEC6	541740136	539216748	99.91	45.72
AEC7	559440240	556289777	99.88	46.68
AEC8	679387311	663914192	99.58	56.21
AEC9	573850780	570593296	99.88	48.07
AEC10	596449290	593128747	99.88	49.64
AEC11	652756659	649577056	99.90	53.92
AEC12	620985576	620605086	99.96	53.04

Supplementary Table S3. Common CNAs as estimated by GISTIC2.0 algorithm.

Cytoband	Event type	# of genes in peak	*q* value	Wide peak boundaries	Focal (≤3 Mb) (IGV)
14q11.2	Loss	1	3.4E-15	chr14:22330001-22459999	YES
9p21.3	Loss	1	3.34E-09	chr9:21889393-21980880	YES
1p36.32	Loss	14	0.026653	chr1:3629062-4739362	YES
1p36.11	Loss	4	0.026653	chr1:26502659-26749362	YES
7p14.1	Loss	3	0.026653	chr7:38230015-38359999	YES
11q23.2	Loss	114	0.026653	chr11:103330016-117108854	NO
13q14.11	Loss	7	0.026653	chr13:40930001-41309999	YES
7q34	Loss	2	0.062579	chr7:142680001-142809999	YES
16p13.13	Loss	3	0.23093	chr16:11180037-11271862	YES
17q22	Gain	299	0.02341	chr17:47830001-69459999	NO
7q22.1	Gain	3	0.037456	chr7:102630001-102709999	NO
7q36.3	Gain	40	0.070254	chr7:152780001-159345973	NO
7q35	Gain	6	0.070254	chr7:144130001-144209999	NO

Supplementary Table S4. Genomic rearrangements detected by WGS.

Sample	Left Chr	Left Position	Right Chr	Right Position	Left Gene	Right Gene	Event Type
AEC1	chr1	20140068	chr17	31132893	PLA2G2F	NF1	CTX
AEC1	chr1	17267652	chr1	17294702	PADI3		ITX
AEC1	chr17	31060858	chr17	45135628		ACBD4	ITX
AEC1	chr17	43474123	chr22	41218293		L3MBTL2	CTX
AEC1	chr17	883021	chr17	1069726	NXN	ABR	ITX
AEC1	chr17	44779466	chr17	44800636	ADAM11	GJC1	ITX
AEC1	chr2	119939902	chr12	74438010	PTPN4		CTX
AEC1	chr2	119939696	chr12	107065890	PTPN4	CRY1	CTX
AEC1	chr2	84216677	chr4	158031053			CTX
AEC1	chr3	16876662	chr6	25626186			CTX
AEC1	chr3	16945366	chr6	149010300	PLCL2	UST	CTX
AEC1	chr3	16295164	chr3	16945557	OXNAD1	PLCL2	ITX
AEC1	chr6	36025894	chr6	149451891		ZC3H12D	ITX
AEC1	chr6	36723392	chr6	25996096	RAB44		ITX
AEC1	chr5	139005088	chrX	39209127	SIL1		CTX
AEC1	chr5	134157156	chrX	40311093	SKP1		CTX
AEC1	chr5	134156745	chrX	40457031	SKP1		CTX
AEC1	chr8	60460322	chr12	46962256			CTX
AEC1	chr8	122767803	chr14	63620916		WDR89	CTX
AEC1	chr8	133884380	chr12	12084932		BCL2L14	CTX
AEC1	chr8	61095218	chr14	34547253			CTX
AEC1	chr8	142070536	chr19	721138		PALM	CTX
AEC1	chr8	142073677	chr19	1252850		MIDN	CTX
AEC1	chr8	142076375	chr19	1247790			CTX
AEC1	chr8	142095810	chr19	3978100		EEF2	CTX
AEC1	chr12	10171321	chr20	32831625	OLR1	MAPRE1	CTX
AEC1	chr12	12084003	chr12	13220899	BCL2L14		ITX
AEC1	chr12	45515926	chr20	33025998			CTX
AEC1	chr14	41200462	chr14	69277912		GALNT16	ITX
AEC1	chr14	41140091	chr14	69277692	LOC644919	GALNT16	ITX
AEC1	chr14	64973417	chr14	34547272	CHURC1-FNTB		ITX
AEC1	chr14	34844220	chr20	33026411	BAZ1A		CTX
AEC1	chr20	31676660	chr15	73206774	BCL2L1	NEO1	CTX
AEC1	chr20	31673191	chr15	73211298	BCL2L1	NEO1	CTX
AEC1	chr19	1021317	chr19	9793124			ITX
AEC1	chr22	25585365	chr22	25288786	ADRBK2		ITX
AEC1	chrX	41447160	chrX	39195485			ITX
AEC1	chrX	40481457	chrX	41332823			ITX
AEC1	chrX	43084668	chrX	39243116			ITX
AEC1	chr4	181974313	chr4	187984316			ITX
AEC1	chr4	188459928	chr4	161232739	LINC01060		ITX
AEC1	chr4	160166690	chr4	179654084			ITX
AEC1	chr4	172659675	chr4	174033608	GALNTL6		ITX
AEC2	chr8	1059412	chr1	4729369	ERICH1-AS1	AJAP1	CTX
AEC2	chr1	26739548	chr12	123732958	ARID1A	ATP6V0A2	CTX
AEC2	chr1	26522476	chr12	123939629		CCDC92	CTX
AEC2	chr1	205681085	chr1	198725290		PTPRC	ITX
AEC2	chr1	205681091	chr1	198725312		PTPRC	ITX
AEC2	chr1	26787973	chr12	123972364	PIGV	CCDC92	CTX
AEC2	chr1	26787976	chr12	132293892	PIGV	GALNT9	CTX

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AEC2	chr1	1693426	chr12	123972375		CCDC92	CTX
AEC2	chr12	132248262	chr12	110370256	GALNT9		ITX
AEC2	chr12	124070679	chr12	123952360	ZNF664-FAM101A	CCDC92	ITX
AEC2	chr12	124038097	chr12	123749499	ZNF664	ATP6V0A2	ITX
AEC2	chr12	124015427	chr2	3884061	ZNF664		CTX
AEC2	chr12	123974020	chr12	123973884	ZNF664	ZNF664	ITX
AEC2	chr7	27197907	chr11	1563338	HOXA13	MOB2	CTX
AEC2	chr2	26084555	chr16	11574153	RAB10	LITAF	CTX
AEC2	chr2	26043974	chr16	10873757	RAB10		CTX
AEC2	chr16	11723812	chr14	34850878	TXNDC11	BAZ1A	CTX
AEC2	chr16	10879279	chr14	34805135	CIITA	BAZ1A	CTX
AEC2	chr16	11345674	chr16	10755111	RMI2	NUBP1	ITX
AEC2	chr14	91990986	chr21	42896991	TRIP11	NDUFV3	CTX
AEC3	chr9	89303704	chr9	19623677		SLC24A2	ITX
AEC3	chr9	5563762	chr9	5684835	PDCD1LG2	KIAA1432	ITX
AEC3	chr9	11952165	chr9	19575071		SLC24A2	ITX
AEC3	chr9	12295278	chr9	89321111		SECISBP2	ITX
AEC3	chr9	106662967	chr9	89324817	RP11-308N19.4	SECISBP2	ITX
AEC3	chr9	12086171	chr9	89348252		SECISBP2	ITX
AEC3	chr2	171893706	chr13	50742564	SLC25A12	DLEU7	CTX
AEC3	chr2	226905851	chr20	36613598	RHBDD1	SLA2	CTX
AEC3	chr2	171950368	chr13	50457176	HAT1	DLEU1	CTX
AEC3	chr2	215972281	chr2	215762450	MREG	LINC00607	ITX
AEC3	chr2	226900198	chr12	55973215	RHBDD1		CTX
AEC3	chr17	36105469	chr20	37199395	CCL4L1	RPN2	CTX
AEC3	chr20	36639926	chr12	55955745	SLA2	PMEL	CTX
AEC3	chr20	35339310	chr20	31524213	UQCC1	HM13	ITX
AEC3	chr18	136706	chr14	29185508			CTX
AEC3	chr18	20917572	chr14	27941242			CTX
AEC3	chr7	76515456	chr7	75292921	UPK3B	AC004980.8	ITX
AEC4	chr9	5079910	chr1	32039623	JAK2	KHDRBS1	CTX
AEC4	chr9	4968684	chr4	79132643		LINC01088	CTX
AEC4	chr9	21818432	chr2	218674109	MTAP	STK36	CTX
AEC4	chr9	22035317	chr11	114180172	CDKN2B-AS1	ZBTB16	CTX
AEC4	chr1	32145400	chr4	79242078	KPNA6	LINC01088	CTX
AEC4	chr5	25708543	chr5	161795389			ITX
AEC4	chr21	13514360	chr18	14644131			CTX
AEC4	chr7	5529032	chr8	127737841	ACTB	MYC	CTX
AEC4	chr7	5529023	chr8	127737836	ACTB	MYC	CTX
AEC4	chr12	9480204	chr12	31200817			ITX
AEC5	chr3	15313224	chr8	127795555	SH3BP5		CTX
AEC5	chr3	23096113	chr3	23115834			ITX
AEC5	chr3	74907430	chr3	75865379			ITX
AEC5	chr3	189741202	chr17	82614650	TP63	WDR45B	CTX
AEC5	chr3	189768330	chr17	82569787	TP63	FOXK2	CTX
AEC5	chr3	130044539	chr3	130087903		ALG1L2	ITX
AEC5	chr1	197556528	chr12	32053966	DENND1B		CTX
AEC5	chr1	198502629	chr12	32053975			CTX
AEC5	chr1	198664423	chr12	32049921	PTPRC		CTX
AEC5	chr1	44285879	chr13	48458896	ERI3	RB1	CTX
AEC5	chr1	198347546	chr12	116946470		FBXW8	CTX
AEC5	chr1	198614393	chr14	23034967		PSMB5	CTX
AEC5	chr1	198453962	chr14	22873870		LRP10	CTX
AEC5	chr1	113068323	chr10	3327500	NR_103777		CTX
AEC5	chr12	31691637	chr14	63783929	AMN1		CTX

AEC5	chr12	116909136	chr14	64150472		SYNE2	CTX
AEC5	chr12	117036403	chr14	22954602		HAUS4	CTX
AEC5	chr12	117076356	chr16	11262097	TESC		CTX
AEC5	chr12	19427542	chr12	19315109		PLEKHA5	ITX
AEC5	chr12	55390615	chr2	177983180		PDE11A	CTX
AEC5	chr14	23007244	chr16	11182095	C14orf93	CLEC16A	CTX
AEC5	chr4	58648650	chr21	25852559			CTX
AEC5	chr4	67824341	chr13	48458729	TMPRSS11D	RB1	CTX
AEC5	chr21	46229250	chr9	91426674	MCM3AP-AS1		CTX
AEC5	chr21	46285949	chr2	161339089		PSMD14	CTX
AEC5	chr21	46325231	chr9	128445529	PCNT	MIR1268A	CTX
AEC5	chr21	46336347	chr9	87067042	PCNT		CTX
AEC5	chr13	82188406	chr19	22179092			CTX
AEC5	chr16	11140108	chr9	127499240	CLEC16A	LRSAM1	CTX
AEC5	chr16	11184399	chr17	15610169		CDRT1	CTX
AEC5	chr9	91389154	chr17	15699483			CTX
AEC5	chr9	91208652	chr9	128559071		MIR1268A	ITX
AEC5	chr9	128557286	chr9	100400287	MIR1268A		ITX
AEC5	chr9	100481469	chr2	162463162	MSANTD3-TMEFF1	KCNH7	CTX
AEC5	chr9	127905673	chr17	15833404			CTX
AEC5	chr9	127898164	chr2	161346579	ST6GALNAC4	PSMD14	CTX
AEC5	chr9	128386614	chr9	110741440	MIR1268A	MUSK	ITX
AEC5	chr9	110756957	chr9	91146448	MUSK		ITX
AEC5	chr9	128677987	chr9	127440656		ZNF79	ITX
AEC5	chr9	87097509	chr9	128557264		MIR1268A	ITX
AEC5	chr17	15874794	chr2	162460760		KCNH7	CTX
AEC5	chr17	15947014	chr17	15609610	ADORA2B	CDRT1	ITX
AEC5	chr2	38745415	chr2	38728122	SRSF7	GALM	ITX
AEC5	chr2	186559861	chr2	180875866		SCHLAP1	ITX
AEC5	chr2	185841711	chr2	180870728		SCHLAP1	ITX
AEC5	chr2	185807365	chr2	186590622	FSIP2	ITGAV	ITX
AEC5	chr2	186583251	chr2	149831083		AC144449.1	ITX
AEC5	chr11	116866136	chr11	119165209	SIK3		ITX
AEC5	chr11	103345835	chr11	119162175	DYNC2H1	ABCG4	ITX
AEC6	chr1	64731989	chr13	93251294		GPC6	CTX
AEC6	chr1	64728758	chr13	110267254		COL4A1	CTX
AEC6	chr1	83395899	chr1	64728814			ITX
AEC6	chr1	83397560	chr13	93606125		GPC6	CTX
AEC6	chr1	218944862	chr12	113509497	MIR548F3		CTX
AEC6	chr1	83377195	chr12	114160537			CTX
AEC6	chr1	220062224	chr12	114159875	BPNT1		CTX
AEC6	chr1	84002675	chr13	105409746			CTX
AEC6	chr1	83984144	chr13	108491574	TTLL7		CTX
AEC6	chr1	83984031	chr13	108558428	TTLL7		CTX
AEC6	chr1	83490911	chr13	108560572			CTX
AEC6	chr1	220046972	chr13	108479246			CTX
AEC6	chr1	219956651	chr13	102992133			CTX
AEC6	chr1	219960124	chr13	105386605			CTX
AEC6	chr1	220044155	chr1	84602665	EPRS		ITX
AEC6	chr1	30834061	chr5	168827086		SLIT3	CTX
AEC6	chr1	30834074	chr17	78136672		TMC8	CTX
AEC6	chr1	117046438	chr10	31486105		ZEB1	CTX
AEC6	chr1	116292526	chr10	31052283			CTX
AEC6	chr1	83516409	chr13	110710480			CTX

AEC6	chr1	83516387	chr13	110282332		COL4A1	CTX
AEC6	chr1	83371327	chr13	102746984		CCDC168	CTX
AEC6	chr1	83371310	chr1	84619933			ITX
AEC6	chr1	83369919	chr13	108491101			CTX
AEC6	chr1	83979428	chr13	93106449	TTLL7		CTX
AEC6	chr1	83396065	chr13	103023561			CTX
AEC6	chr13	93606047	chr12	113511150	GPC6		CTX
AEC6	chr13	93276601	chr12	113509526	GPC6		CTX
AEC6	chr13	105041462	chr12	114147246			CTX
AEC6	chr13	99694096	chr12	114159882	CLYBL		CTX
AEC6	chr13	108938391	chr13	93249533	MYO16	GPC6	ITX
AEC6	chr13	93250212	chr13	108234346	GPC6		ITX
AEC6	chr13	93252361	chr13	108935829	GPC6	MYO16	ITX
AEC6	chr13	93341048	chr13	110715385	GPC6	ING1	ITX
AEC6	chr13	93588773	chr13	105385792	GPC6		ITX
AEC6	chr13	110375973	chr13	103964555	COL4A2		ITX
AEC6	chr13	110260017	chr13	99658012	COL4A1	CLYBL	ITX
AEC6	chr13	110378179	chr21	10359850	COL4A2		CTX
AEC6	chr13	110378188	chr13	108676294	COL4A2	MYO16	ITX
AEC6	chr13	102750933	chr1	84619916	CCDC168		CTX
AEC6	chr13	100404291	chr13	93269213	PCCA	GPC6	ITX
AEC6	chr13	100379822	chr13	93276628	PCCA	GPC6	ITX
AEC6	chr13	103023525	chr13	102748220		CCDC168	ITX
AEC6	chr13	110267205	chr13	108561586	COL4A1		ITX
AEC6	chr13	108439116	chr13	99652421		CLYBL	ITX
AEC6	chr13	108234815	chr13	102748173		CCDC168	ITX
AEC6	chr12	72845798	chr15	94345318		MCTP2	CTX
AEC6	chr12	72845792	chr15	94343061		MCTP2	CTX
AEC6	chr12	8208944	chr12	8238302		FAM86FP	ITX
AEC6	chr5	168827086	chr17	78136862	SLIT3	TMC8	CTX
AEC6	chr5	162325516	chr7	83343036			CTX
AEC6	chr17	75983468	chr17	39964350	TEN1	GSDMA	ITX
AEC6	chr7	80673631	chr5	162325460	CD36		CTX
AEC6	chr7	26213351	chr15	40561991	CBX3	C15orf57	CTX
AEC6	chr9	22004355	chr18	9401812	CDKN2B	TWSG1	CTX
AEC6	chr9	22007680	chr18	8629710	CDKN2B	RAB12	CTX
AEC6	chr9	22007599	chr9	21856928	CDKN2B	MTAP	ITX
AEC6	chr9	20879240	chr9	22077243	FOCAD	CDKN2B	ITX
AEC6	chr18	9401930	chr18	9384327	TWSG1	TWSG1	ITX
AEC6	chr10	30339479	chr10	32365202	MTPAP	EPC1	ITX
AEC6	chr10	31872784	chr10	30630055	ARHGAP12		ITX
AEC6	chr10	43742077	chr4	169269309		SH3RF1	CTX
AEC6	chr8	129844539	chr8	130112458	FAM49B	ASAP1	ITX
AEC6	chr19	42749309	chr19	42862972			ITX
AEC7	chr1	10014819	chr5	20316653	RBP7		CTX
AEC7	chr1	25405617	chr1	25287800	RHCE	RHD	ITX
AEC7	chr1	25283536	chr1	25409859	RHD	RHCE	ITX
AEC7	chr1	27211316	chr1	25675807		MAN1C1	ITX
AEC7	chr10	90018470	chr9	82397436			CTX
AEC7	chr10	92007693	chr9	92683743	BTAF1		CTX
AEC7	chr10	90016738	chr9	91450722			CTX
AEC7	chr10	95664574	chr9	91442400	TCTN3		CTX
AEC7	chr10	94210013	chr9	92729035	PLCE1	BICD2	CTX
AEC7	chr10	96215461	chr10	81133552	BLNK		ITX
AEC7	chr10	99721399	chr10	116437519	COX15	PNLIPRP3	ITX

AEC7	chr10	113682580	chr10	81228393	CASP7		ITX
AEC7	chr10	116805991	chr10	122531890			ITX
AEC7	chr10	119692614	chr10	75623610			ITX
AEC7	chr10	119824525	chr9	91602266	INPP5F		CTX
AEC7	chr10	122334504	chr10	91886348	BTBD16		ITX
AEC7	chr10	122367065	chr10	75568004			ITX
AEC7	chr10	122652100	chr9	74344556			CTX
AEC7	chr10	101354971	chr10	123564973	BTRC		ITX
AEC7	chr10	101355699	chr10	116473440	BTRC	PNLIPRP3	ITX
AEC7	chr10	101354566	chr10	80937860	BTRC		ITX
AEC7	chr10	101949226	chr10	91885642	C10orf76		ITX
AEC7	chr10	73859471	chr9	96417608	CAMK2G	ZNF367	CTX
AEC7	chr10	123515826	chr10	80937979			ITX
AEC7	chr10	22670939	chr4	142893122	PIP4K2A		CTX
AEC7	chr10	96084840	chr9	77467654	ENTPD1	GNA14	CTX
AEC7	chr10	96084950	chr9	92787087	ENTPD1		CTX
AEC7	chr10	81230002	chr10	80964937			ITX
AEC7	chr11	38791108	chr8	51818922		PCMTD1	CTX
AEC7	chr11	38791119	chr8	51817583		PCMTD1	CTX
AEC7	chr12	2749693	chr9	78316972		PSAT1	CTX
AEC7	chr12	2749715	chr9	78317575		PSAT1	CTX
AEC7	chr13	40550173	chr22	42858103			CTX
AEC7	chr13	50170283	chr22	42858094	DLEU1		CTX
AEC7	chr16	3570433	chr8	54007443	NLRC3	TCEA1	CTX
AEC7	chr16	3230701	chr8	38722308	ZNF200		CTX
AEC7	chr16	7765479	chr8	37979135			CTX
AEC7	chr16	3570567	chr16	7765348	NLRC3		ITX
AEC7	chr16	10973785	chr8	65185169	CLEC16A		CTX
AEC7	chr16	11134114	chr8	65185552	CLEC16A		CTX
AEC7	chr16	11189716	chr8	65107695			CTX
AEC7	chr16	11399715	chr8	65185564			CTX
AEC7	chr17	75571116	chrX	123677931	LLGL2	THOC2	CTX
AEC7	chr17	75945385	chr17	75934351	ACOX1	FBF1	ITX
AEC7	chr19	3430767	chr8	104254688	NFIC		CTX
AEC7	chr2	224155575	chrX	93441685			CTX
AEC7	chr2	224155838	chrX	93441686			CTX
AEC7	chr20	39785799	chr20	55807996			ITX
AEC7	chr20	40266442	chr20	55831132			ITX
AEC7	chr3	798946	chr8	54007443	AC090044.1	TCEA1	CTX
AEC7	chr5	122052636	chr5	119083829		DMXL1	ITX
AEC7	chr5	119083559	chr5	85144619	DMXL1		ITX
AEC7	chr5	163327256	chr5	119848430			ITX
AEC7	chr5	119848179	chr5	166193392			ITX
AEC7	chr8	38758586	chr8	38053002	TACC1	EIF4EBP1	ITX
AEC7	chr8	38052917	chr8	38756098	EIF4EBP1	TACC1	ITX
AEC7	chr8	38722644	chr8	38756084		TACC1	ITX
AEC7	chr9	32800112	chr9	32013494			ITX
AEC7	chr9	32024784	chr9	39461331		LOC653501	ITX
AEC7	chr9	19580335	chr9	38489981	SLC24A2		ITX
AEC7	chr9	87987523	chr9	93510567		FAM120A	ITX
AEC7	chr9	92721364	chr9	92732954	BICD2	BICD2	ITX
AEC7	chr9	92721548	chr9	92795369	BICD2		ITX
AEC7	chr9	92800558	chr9	93510530		FAM120A	ITX
AEC7	chr9	74283906	chr9	93514529		FAM120A	ITX
AEC8	chr1	25409770	chr1	25283647	RHCE	RHD	ITX

AEC8	chr1	25287800	chr1	25405617	RHD	RHCE	ITX
AEC8	chr1	18284571	chr10	114637891	IGSF21	ABLIM1	CTX
AEC8	chr1	103405427	chr11	87053566		TMEM135	CTX
AEC8	chr1	103405431	chr11	87053357		TMEM135	CTX
AEC8	chr1	37665678	chr10	132599768		INPP5A	CTX
AEC8	chr11	88485271	chr11	90689470		DISC1FP1	ITX
AEC8	chr11	117098870	chr11	86142353			ITX
AEC8	chr17	1945880	chr6	32069496	RTN4RL1	TNXB	CTX
AEC8	chr6	109445980	chr12	112099734	MICAL1	NAA25	CTX
AEC8	chr6	109446113	chr12	111929692	MICAL1		CTX
AEC8	chr6	87665276	chr12	111430889	ORC3	SH2B3	CTX
AEC8	chr6	87665929	chr12	111403737	ORC3		CTX
AEC8	chr6	23572828	chr9	108706611			CTX
AEC8	chr6	32452401	chr9	133858357		VAV2	CTX
AEC8	chr6	24059038	chr6	18683201			ITX
AEC8	chr12	122862478	chr12	111449239	HIP1R	SH2B3	ITX
AEC8	chr16	15603925	chr16	15660588	KIAA0430	NDE1	ITX
AEC8	chr19	20560173	chr19	21115661	ZNF737	ZNF714	ITX
AEC8	chr9	110488690	chr9	116899693	SVEP1	ASTN2	ITX
AEC9	chr9	5080317	chr8	18019988	JAK2	PCM1	CTX
AEC9	chr8	127737753	chr5	171406691	MYC	NPM1	CTX
AEC9	chr8	127737261	chr5	171408322	MYC	NPM1	CTX
AEC9	chr8	205295	chr5	143466459			CTX
AEC9	chr3	135651831	chr17	4686085		PELP1	CTX
AEC9	chr3	134856386	chr4	2346987	EPHB1	ZFYVE28	CTX
AEC9	chr17	4469693	chr4	2354361	SPNS3	ZFYVE28	CTX
AEC9	chr17	48938056	chr17	47850903	SNF8	SP6	ITX
AEC9	chr17	48939794	chr17	1057058	SNF8	ABR	ITX
AEC9	chr17	15722593	chr17	15162258			ITX
AEC9	chr5	157587723	chr5	158445017			ITX
AEC9	chr5	158330451	chr5	157421668	NR_109888		ITX
AEC9	chr6	167069697	chr1	110378439		SLC16A4	CTX
AEC9	chr6	135537358	chr1	110378439	LINC00271	SLC16A4	CTX
AEC9	chr19	42862979	chr19	42749278			ITX
AEC10	chr1	79860889	chr9	69839559		C9orf135	CTX
AEC10	chr1	64602481	chr12	87897718	CACHD1		CTX
AEC10	chr1	64563812	chr9	75314505	CACHD1		CTX
AEC10	chr1	9008486	chr12	106794595	SLC2A7	RIC8B	CTX
AEC10	chr1	35288965	chr12	108783619	ZMYM4	SSH1	CTX
AEC10	chr1	80139699	chr9	101594066		GRIN3A	CTX
AEC10	chr1	80144495	chr9	77908751		GNAQ	CTX
AEC10	chr1	51094645	chr1	28156353		PTAFR	ITX
AEC10	chr1	51294532	chr1	2531314	TTC39A		ITX
AEC10	chr1	10540911	chr1	45550546	PEX14		ITX
AEC10	chr1	12366235	chr1	39654492	VPS13D		ITX
AEC10	chr1	8390244	chr12	106967245	RERE	C12orf23	CTX
AEC10	chr1	62703320	chr1	6308580		ACOT7	ITX
AEC10	chr1	51523929	chr1	12366405		VPS13D	ITX
AEC10	chr1	3649015	chr1	15432769	WRAP73		ITX
AEC10	chr1	40914737	chr12	106772640		NR_040246	CTX
AEC10	chr1	15419777	chr1	29075970	EFHD2	EPB41	ITX
AEC10	chr1	35286367	chr1	23568593	ZMYM4		ITX
AEC10	chr1	32482941	chr1	31231303	ZBTB8B	NKAIN1	ITX
AEC10	chr1	39008020	chr1	1356580		MXRA8	ITX
AEC10	chr1	39385138	chr1	27228483	MACF1		ITX

AEC10	chr1	27608593	chr1	25786901			ITX
AEC10	chr1	27412688	chr1	25791866	WASF2		ITX
AEC10	chr9	20617531	chr9	19969915	MLLT3		ITX
AEC10	chr9	19970735	chr9	22630091			ITX
AEC10	chr9	21889391	chr9	77822033		GNAQ	ITX
AEC10	chr9	22131740	chr9	77319121		VPS13A	ITX
AEC10	chr9	98738118	chr12	111435728	ANKS6	SH2B3	CTX
AEC10	chr9	71290888	chr9	71329980			ITX
AEC10	chr9	101673476	chr12	103336339	GRIN3A	C12orf42	CTX
AEC10	chr9	77313914	chr9	21784375	VPS13A		ITX
AEC10	chr9	21792709	chr9	21811839		MTAP	ITX
AEC10	chr9	21810463	chr9	69869540	MTAP	C9orf135	ITX
AEC10	chr9	71295528	chr9	71334561			ITX
AEC10	chr9	70492176	chr12	83744544			CTX
AEC10	chr9	70489179	chr9	101703897		GRIN3A	ITX
AEC10	chr9	77628920	chr9	77974023	GNA14	GNAQ	ITX
AEC10	chr11	83468062	chr11	83381535	DLG2		ITX
AEC10	chr11	123884505	chr11	83465108	TMEM225	DLG2	ITX
AEC10	chr19	1035901	chr19	4367450	CNN2	SH3GL1	ITX
AEC10	chr19	3290257	chr19	2745664	CELF5		ITX
AEC10	chr17	39569583	chr17	69460776		MAP2K6	ITX
AEC11	chr9	5078551	chr3	100746030	JAK2	TFG	CTX
AEC11	chr9	28175753	chr3	101093018	LINGO2		CTX
AEC11	chr9	28332763	chr3	102357923	LINGO2		CTX
AEC11	chr9	5038566	chr3	154387964	JAK2	GPR149	CTX
AEC11	chr9	12319329	chr3	152749684			CTX
AEC11	chr9	12319369	chr3	153155580			CTX
AEC11	chr3	154650989	chr3	144576737			ITX
AEC11	chr4	85667717	chr4	85676261	ARHGAP24	ARHGAP24	ITX
AEC11	chr10	30730687	chr10	13733789		FRMD4A	ITX
AEC11	chr10	15068404	chr13	48408244	OLAH	RB1	CTX
AEC11	chr13	42164770	chr13	42119759	DGKH	DGKH	ITX
AEC11	chr13	54550229	chr13	44403640		LINC01071	ITX
AEC11	chr13	42162239	chr13	48502130	DGKH	RCBTB2	ITX
AEC11	chr13	42161944	chr13	98759040	DGKH		ITX
AEC11	chr13	98759017	chr13	43217900		ENOX1	ITX
AEC11	chr13	43108028	chr13	37289185	DNAJC15		ITX
AEC12	chr4	90866416	chr10	3091320	CCSER1	PFKP	CTX
AEC12	chr4	553690	chr4	91578474		CCSER1	ITX
AEC12	chr4	158090996	chr11	99097765		CNTN5	CTX
AEC12	chr4	164894119	chr4	64212883	APELA		ITX
AEC12	chr4	26419171	chr10	14728737	RBPJ	FAM107B	CTX
AEC12	chr4	12156928	chr10	14643105		FAM107B	CTX
AEC12	chr4	47180234	chr10	17540396	GABRB1		CTX
AEC12	chr4	27066312	chr10	22930454		ARMC3	CTX
AEC12	chr4	12501182	chr10	2900711			CTX
AEC12	chr4	6322310	chr10	2464399	PPP2R2C		CTX
AEC12	chr4	16867190	chr10	6979892	LDB2		CTX
AEC12	chr4	12756285	chr20	50225390			CTX
AEC12	chr4	17132097	chr20	51330510			CTX
AEC12	chr4	64186071	chr20	16510717		KIF16B	CTX
AEC12	chr4	90096995	chr11	99707672		CNTN5	CTX
AEC12	chr4	96493312	chr4	166652936			ITX
AEC12	chr4	94782175	chr4	154331920	BMPR1B	DCHS2	ITX
AEC12	chr4	166411981	chr4	66203459			ITX

AEC12	chr4	13097168	chr4	89960221				ITX
AEC12	chr4	5044605	chr10	14750621			FAM107B	CTX
AEC12	chr4	19039544	chr4	18058678				ITX
AEC12	chr4	16336127	chr10	10951513			LINC00710	CTX
AEC12	chr4	16917247	chr10	605692			DIP2C	CTX
AEC12	chr4	16927197	chr10	16212715				CTX
AEC12	chr4	16927984	chr10	10807109				CTX
AEC12	chr4	17035651	chr10	16212262				CTX
AEC12	chr4	27029603	chr10	16213869				CTX
AEC12	chr4	27030219	chr10	10807132				CTX
AEC12	chr4	27030566	chr10	10949788			LINC00710	CTX
AEC12	chr4	27026531	chr10	10807692				CTX
AEC12	chr4	710817	chr10	10949385	PCGF3		LINC00710	CTX
AEC12	chr4	35450011	chr10	16855192			CUBN	CTX
AEC12	chr4	67290782	chr4	154329745			DCHS2	ITX
AEC12	chr4	13378107	chr11	99076783	RAB28		CNTN5	CTX
AEC12	chr4	154344559	chr4	71604824	DCHS2			ITX
AEC12	chr4	155337665	chr4	164009116			MARCH1	ITX
AEC12	chr4	17087652	chr4	35449500				ITX
AEC12	chr4	35448956	chr10	17096547			CUBN	CTX
AEC12	chr4	35449243	chr10	10807841				CTX
AEC12	chr4	708517	chr4	10180980	PCGF3			ITX
AEC12	chr4	92548219	chr11	83478712	GRID2		DLG2	CTX
AEC12	chr10	10810750	chr4	16975491				CTX
AEC12	chr10	14172703	chr10	16171330	FRMD4A			ITX
AEC12	chr10	16170932	chr10	16171684				ITX
AEC12	chr10	10811078	chr10	22605357			PIP4K2A	ITX
AEC12	chr11	110077757	chr20	5089181				CTX
AEC12	chr11	125672128	chr11	82652789	CHEK1			ITX
AEC12	chr11	99123808	chr21	10563181	CNTN5		TPTE	CTX
AEC12	chr11	55667022	chr11	55597046				ITX
AEC12	chr11	55690280	chr11	55676540				ITX
AEC12	chr11	55678392	chr11	55597952				ITX
AEC12	chr11	55664075	chr11	55597413				ITX
AEC12	chr11	16642841	chr11	14173218			SPON1	ITX
AEC12	chr20	50225270	chr22	20048583			TANGO2	CTX
AEC12	chr20	10736490	chr20	17276709			PCSK2	ITX
AEC12	chr21	28178778	chr1	99175903				CTX
AEC12	chr13	48870415	chr13	26196890				ITX
AEC12	chr13	28246182	chr13	40443971	PAN3		LINC00598	ITX
AEC12	chr13	40618781	chr13	48742994	FOXO1			ITX
AEC12	chr13	49088715	chr13	48743056	FNDC3A			ITX
AEC12	chr13	83996889	chr13	40853955			TPTE2P5	ITX
AEC12	chr13	83996844	chr13	37807831			TRPC4	ITX
AEC12	chr1	99160374	chr1	99176144				ITX

CTX, interchromosomal rearrangement; ITX, intrachromosomal rearrangement.

Supplementary Table S5. Verified focal (≤3Mb) minimal common regions (MCRs) between copy number alterations.

Cytogenetic band	Copy number alteration	Chromosome Coordinates MCR		Size	Cancer genes (NCG 6.0)	Affected patients (%)
		Start	End			
9p21.3	Loss	21900000	22050000	150 Kb	CDKN2A, CDKN2B	10 (83)
1p36.11	Loss	26522477	26739547	217 Kb	ARID1A	5 (41)
13q14.11	Loss	40950000	41300000	350 Kb	ELF1	5 (41)
1p36.33-p36.32	Loss	1693426	4729368	3.0 Mb	CFAP74, PLCH2, TNFRSF14, PRDM16	4 (33)
1p36.22	Loss	9008487	10050000	1.0 Mb	PIK3CD, MIR34AHG	4 (33)
9q21.33	Loss	87067043	87097508	30 Kb	None	4 (33)
12q24.12	Loss	111411959	111430892	18 Kb	SH2B3	4 (33)
13q13.3-q14.11	Loss	37807832	40443889	2.6 Mb	None	4 (33)
4q13.1-q13.2	Loss	64598833	66203458	1.6 Mb	EPHA5	3 (25)
9q31.1	Loss	101850000	102300000	450 Kb	None	3 (25)
10p11.22	Loss	31050000	31500000	450 Kb	ZEB1	3 (25)
10p11.22	Loss	31850000	32350000	500 Kb	KIF5B, EPC1	3 (25)
10p13	Loss	14750622	15050000	300 kb	None	3 (25)
10q26.13	Loss	121750000	122500000	750 Kb	None	3 (25)
11q14.2	Loss	86142354	88485270	2.3 Mb	EED, C11orf73, CCDC81	3 (25)
13q11	Loss	18050000	18650000	600 Kb	None	3 (25)
16p13.13	Loss	11140109	11262096	121 Kb	SOCS1	3 (25)
17p13.3	Loss	0	1050000	1 Mb	None	3 (25)
19p13.3	Loss	700000	1250000	550 Kb	ABCA7, STK11, C19orf26	3 (25)
7q32.3	Gain	131750000	132950000	1.2 Mb	None	8 (66)
7q11.22	Gain	69600000	70800000	1.2 Mb	None	6 (50)
7p22.3	Gain	300000	350000	50 Kb	None	3 (25)
17q21.31	Gain	43500000	45150000	1.6 Mb	ETV4	4 (33)
17q25.3	Gain	83050000	83257441	207 Kb	None	3 (25)
10p13	Loss	14750622	16855191	2.1 Mb	FAM171A1	2 (16)
13q12.3	Loss	28246183	29031793	785 Kb	FLT1	2 (16)
13q31.3-q32.1	Loss	93100000	93600000	500 Kb	GPC6	2 (16)
13q34	Loss	108700000	110350000	1.6 Mb	COL4A2	2 (16)
14q13.1-q13.2	Loss	34500000	34850000	350 Kb	SNX6, CFL2, BAZ1A	2 (16)
14q23.2	Loss	63750000	64150000	400 Kb	SYNE2	2 (16)
21q22.12	Loss	33917299	35875844	1.9 Mb	SLC5A3, RUNX1	2 (16)
Xp11.4	Loss	39250000	40300000	1.0 Mb	BCOR	2 (16)

3p25.3	Gain	10300000	11050000	750 Kb	SLC6A11	2 (16)
8p11.21	Gain	41550000	43350000	1.8 Mb	AGPAT6, KAT6A, HOOK3	2 (16)
9q21.2	Gain	75314504	77313915	1.9 Mb	PRUNE2	2 (16)
12p13.2	Gain	11350000	11400000	50 Kb	PRB2	2 (16)
21q22.3	Gain	44250000	46709983	2.4 Mb	TSPEAR, FTCD	2 (16)
Xq28	Gain	154700000	156040895	1.4 Mb	F8, MTCP1, SPRY3	2 (16)

Supplementary Table S6. Indels and SNVs predicted as deleterious by Polyphen-2 & SIFT.

Gene	Chr	Position	Exon	Type	Nucleotide change	Peptide change	Consequence	SIFT	PolyPhen-2	Samples (VAF)
ARID1A	chr1	26729799	2/20	SNV	c.1286G>A	p.R429Q	missense_variant	deleterious(0)	possibly_damaging(0.558)	AEC3 (0.18)
ARID1A	chr1	26774847	18/20	SNV	c.4620C>A	p.N1540K	missense_variant	deleterious(0.01)	unknown(0)	AEC5 (0.56)
ARID1A	chr1	26779441	20/20	SNV	c.5543G>T	p.G1848V	missense_variant	deleterious(0)	possibly_damaging(0.507)	AEC3 (0.39)
BTK	chrX	101356893	14/19	SNV	c.1342G>A	p.G448R	missense_variant	deleterious(0)	probably_damaging(1)	AEC5 (0.16)
CABIN1	chr22	24070872	17/37	SNV	c.2305C>T	p.Q769*	stop_gained			AEC5 (0.45)
CACNA1D	chr3	53702657	9/49	SNV	c.1237A>T	p.R413*	stop_gained			AEC3 (0.16)
CACNA1D	chr3	53702656	9/49	SNV	c.1236A>T	p.E412D	missense_variant	deleterious(0)	probably_damaging(0.994)	AEC3 (0.16)
CACNA1D	chr3	53718689	11/49	deletion	c.1492_1497del	p.R498_R499del	inframe_deletion			AEC8 (0.46)
CARD11	chr7	2939751	6/25	SNV	c.862C>T	p.Q288*	stop_gained			AEC5 (0.29)
CBLB	chr3	105853646	3/19	SNV	c.187C>T	p.P63S	missense_variant	deleterious(0.02)	probably_damaging(0.971)	AEC1 (0.34)
CCND3	chr6	41935922	5/5	deletion	c.863_*17del		3_prime_UTR_variant			AEC11 (0.30)
CD58	chr1	116521959	4/6	deletion	c.645_652del	p.R215Sfs*24	frameshift_variant			AEC6 (0.67)
CDH1	chr16	68808826	5/16	SNV	c.665G>A	p.R222K	missense_variant	deleterious(0)	probably_damaging(0.998)	AEC8 (0.24)
CDKN2A	chr9	21971154	2/4	SNV	c.205G>T	p.E69*	stop_gained			AEC3 (0.17)
CHEK2	chr22	28695190	13/16	SNV	c.1441G>T	p.D481Y	missense_variant	deleterious(0)	probably_damaging(0.915)	AEC12 (0.32)
DHX58	chr17	42109364	6/14	SNV	c.584G>A	p.W195*	stop_gained			AEC12 (0.64)
EED	chr11	86252159	3/13	deletion	c.280_315del	p.Q94_S105del	inframe_deletion			AEC7 (0.83)
EGFR	chr7	55156823	10/28	SNV	c.1198G>A	p.E400K	missense_variant	deleterious(0.02)	probably_damaging(0.971)	AEC3 (0.16)
EPHA2	chr1	16131793	14/17	SNV	c.2403G>A	p.W801*	stop_gained			AEC5 (0.36)
EZH2	chr7	148829756	5/20	deletion	c.455delA	p.N152Ifs*15	frameshift_variant			AEC12 (0.57)
FGFR2	chr10	121479957	18/18	SNV	c.2369C>T	p.S790F	missense_variant	deleterious(0)	probably_damaging(0.998)	AEC4 (0.36)
FGFR4	chr5	177096659	16/18	SNV	c.2071C>T	p.P691S	missense_variant	deleterious(0)	probably_damaging(0.999)	AEC3 (0.18)
FLT4	chr5	180616920	22/30	SNV	c.3076G>A	p.E1026K	missense_variant	deleterious(0)	probably_damaging(0.991)	AEC3 (0.17)
JAK2	chr9	5065003	9/25	SNV	c.1177C>G	p.L393V	missense_variant	tolerated(0.36)	benign(0.038)	AEC3 (0.5)
JAK3	chr19	17835161	15/24	SNV	c.1969C>T	p.R657W	missense_variant	deleterious(0)	probably_damaging(0.999)	AEC5 (0.22)
JAK3	chr19	17838299	11/24	SNV	c.1533G>A	p.M511I	missense_variant	tolerated(0.17)	benign(0.098)	AEC12 (0.24)
KDR	chr4	55098218	17/30	SNV	c.2428G>A	p.E810K	missense_variant	deleterious(0)	probably_damaging(0.953)	AEC5 (0.57)
KIT	chr4	54698416	3/21	SNV	c.470C>T	p.P157L	missense_variant	deleterious(0.04)	probably_damaging(0.98)	AEC6 (0.17)
KMT2C	chr7	152148927	52/59	SNV	c.13000C>T	p.R4334W	missense_variant	deleterious(0)	probably_damaging(0.978)	AEC1 (0.44)
KMT2D	chr12	49029123	44/54	SNV	c.14189G>A	p.W4730*	stop_gained			AEC5 (0.33)
KMT2D	chr12	49037359	34/54	SNV	c.9997C>T	p.Q3333*	stop_gained			AEC6 (0.34)
KMT2D	chr12	49038031	34/54	deletion	c.9324delA	p.E3108Dfs*11	frameshift_variant			AEC6 (0.31)
KMT2D	chr12	49054910	2/54	SNV	c.166C>T	p.Q56*	stop_gained			AEC3 (0.18)

Gene	Chr	Position	Ratio	Type	cDNA	Protein	Effect	SIFT	PolyPhen	AEC
NCOR1	chr17	16062118	36/46	SNV	c.5374C>T	p.Q1792*	stop_gained			AEC6 (0.15)
NCOR1	chr17	16062253	36/46	SNV	c.5239C>T	p.R1747*	stop_gained			AEC11 (0.46)
PDGFRA	chr4	54287457	19/23	SNV	c.2590C>T	p.P864S	missense_variant	deleterious(0)	probably_damaging(1)	AEC4 (0.47)
PIK3CB	chr3	138684773	15/22	SNV	c.2167A>T	p.N723Y	missense_variant	deleterious(0)	probably_damaging(0.984)	AEC5 (0.35)
PIM1	chr6	37173167	5/6	SNV	c.779C>T	p.S260F	missense_variant	deleterious(0)	probably_damaging(0.999)	AEC4 (0.36)
RPS6KA3	chrX	20194263	6/22	insertion	c.411dupT	p.Q138Sfs*3	frameshift_variant			AEC7 (0.83)
RUNX1T1	chr8	92014703	4/12	SNV	c.521C>T	p.P174L	missense_variant	deleterious(0)	probably_damaging(0.998)	AEC7 (0.49)
SETD1B	chr12	121805871	4/18	SNV	c.310C>T	p.Q104*	stop_gained			AEC6 (0.3)
SETD2	chr3	47122472	3/21	SNV	c.2164C>T	p.Q722*	stop_gained			AEC5 (0.19)
SETD6	chr16	58516222	3/8	SNV	c.355C>T	p.Q119*	stop_gained			AEC2 (0.24)
SH2B3	chr12	111418245	2/8	deletion	c.104_128del	p.V35Afs*154	frameshift_variant			AEC6 (0.30)
SH2B3	chr12	111418744	2/8	insertion	c.599_600ins	p.L201Sfs*78	frameshift_variant			AEC2 (0.17)
SH2B3	chr12	111418745	2/8	deletion	c.601_604del	p.L201Afs*76	frameshift_variant			AEC2 (0.2)
SH2B3	chr12	111418810	2/8	SNV	c.665T>C	p.L222P	missense_variant	deleterious(0)	probably_damaging(0.974)	AEC6 (0.23)
SOCS1	chr16	11255162	2/2	SNV	c.317G>A	p.S106N	missense_variant	deleterious(0)	probably_damaging(1)	AEC8 (0.44)
SOCS1	chr16	11255265	2/2	deletion	c.213delC	p.S71Rfs*14	frameshift_variant			AEC5 (0.48)
SOCS1	chr16	11255267	2/2	deletion	c.185_211del	p.A62_S71delinsG	inframe_deletion			AEC5 (0.44)
STAT3	chr17	42323081	20/24	SNV	c.1811G>C	p.G604A	missense_variant	deleterious(0.01)	possibly_damaging(0.558)	AEC9 (0.41)
STAT3	chr17	42348461	2/24	SNV	c.56A>G	p.H19R	missense_variant	tolerated(0.05)	possibly_damaging(0.742)	AEC4 (0.4)
STAT5B	chr17	42202782	17/19	SNV	c.2104C>T	p.P702S	missense_variant	deleterious(0.04)	possibly_damaging(0.857)	AEC2 (0.3)
STAT5B	chr17	42207641	16/19	SNV	c.1994A>T	p.Y665F	missense_variant	tolerated(0.16)	possibly_damaging(0.498)	AEC7 (0.14)
STAT5B	chr17	42207711	16/19	SNV	c.1924A>C	p.N642H	missense_variant	tolerated(0.09)	probably_damaging(0.935)	AEC1 (0.76); AEC6 (0.53)
STAT5B	chr17	42217239	11/19	SNV	c.1301C>T	p.S434L	missense_variant	deleterious(0)	benign(0.242)	AEC8 (0.2)
TBL1X	chrX	9693396	11/18	deletion	c.1034delT	p.L345*	frameshift_variant			AEC12 (0.39)
TBL1XR1	chr3	177047307	9/16	SNV	c.857T>G	p.V286G	missense_variant	deleterious(0)	possibly_damaging(0.599)	AEC8 (0.24)
TCF12	chr15	57232847	11/21	deletion	c.962_970+54del		splice_donor_variant			AEC6 (0.47)
TP53	chr17	7673704	8/11	SNV	c.916C>T	p.R306*	stop_gained			AEC3 (0.23)
TP53	chr17	7674257	7/11	SNV	c.706T>C	p.Y236H	missense_variant	deleterious(0)	probably_damaging(0.994)	AEC1 (0.45)

Supplementary Table S7. Genes screened for deleterious indels and SNVs.

	Genes
A	ABL1, ACTB, ACTL6A, ACTL6B, ADCY1, ADCY2, ADCY3, ADCY4, ADCY5, ADCY6, ADCY7, ADCY8, ADCY9, AEBP2, AGER, AGTR1, AICDA, AIM2, AKT1, AKT1, AKT2, AKT3, ALOX5, ANAPC1, ANAPC10, ANAPC11, ANAPC13, ANAPC2, ANAPC4, ANAPC5, ANAPC7, ANGPT1, ANGPT2, ANGPT4, AOX1, APC, APC2, APEX1, APPL1, AR, ARAF, ARHGEF1, ARHGEF11, ARHGEF12, ARHGEF3, ARID1A, ARID1B, ARID2, ARID4A, ARID4B, ARID5B, ARIH2, ARNT, ARNT2, ARRB1, ARRB2, ASH1L, ASH2L, ATF2, ATF4, ATF6B, ATF7IP, ATM, ATR, ATRAID, ATXN7, ATXN7L3, AXIN1, AXIN2.
B	B2M, BACH2, BAD, BATF, BAX, BCL10, BCL11B, BCL2, BCL2L1, BCL2L11, BCL6, BCOR, BCR, BDKRB1, BDKRB2, BDNF, BID, BIRC2, BIRC3, BIRC5, BIRC7, BIRC8, BLK, BLNK, BMI1, BMP2, BMP4, BMX, BRAF, BRCA1, BRCA2, BRD1, BRD8, BRMS1, BRPF1, BRPF3, BRWD1, BTK, BUB1, BUB1B, BUB3.
C	C1QBP, C8orf44-SGK3, CABIN1, CACNA1A, CACNA1B, CACNA1C, CACNA1D, CACNA1E, CACNA1F, CACNA1G, CACNA1H, CACNA1I, CACNA1S, CACNA2D1, CACNA2D2, CACNA2D3, CACNA2D4, CACNB1, CACNB2, CACNB3, CACNB4, CACNG1, CACNG2, CACNG3, CACNG4, CACNG5, CACNG6, CACNG7, CACNG8, CALCOCO2, CALM1, CALM2, CALM3, CARD11, CARD9, CARM1, CASP3, CASP8, CASP9, CBL, CBLB, CBLC, CCDC6, CCL2, CCL5, CCNA1, CCNA2, CCNB1, CCNB2, CCNB3, CCND1, CCND2, CCND3, CCNE1, CCNE2, CCNH, CCR2, CCR4, CD14, CD19, CD247, CD274, CD276, CD28, CD2AP, CD34, CD38, CD3D, CD3E, CD3G, CD4, CD40LG, CD44, CD46, CD58, CD79A, CD80, CD82, CD86, CD8A, CD8B, CDC14A, CDC14B, CDC16, CDC20, CDC23, CDC25A, CDC25B, CDC25C, CDC26, CDC27, CDC37, CDC42, CDC45, CDC6, CDC7, CDCP1, CDH1, CDIP1, CDK1, CDK2, CDK4, CDK6, CDK7, CDKN1A, CDKN1B, CDKN1C, CDKN2A, CDKN2B, CDKN2C, CDKN2D, CEACAM1, CEACAM5, CEBPA, CEBPB, CEBPD, CHAD, CHD3, CHD4, CHEK1, CHEK2, CHRM1, CHRM2, CHUK, CIITA, CISH, CKS1B, CKS2, CLOCK, CNTF, CNTFR, COL1A1, COL1A2, COL2A1, COL4A1, COL4A2, COL4A3, COL4A4, COL4A5, COL4A6, COL6A1, COL6A2, COL6A3, COL6A5, COL6A6, COL9A1, COL9A2, COL9A3, COMP, COPRS, CREB1, CREB3, CREB3L1, CREB3L2, CREB3L3, CREB3L4, CREB5, CREBBP, CRK, CRKL, CRLF2, CRTC2, CSF1, CSF1R, CSF2, CSF2RA, CSF2RB, CSF3, CSF3R, CSH1, CSH2, CSK, CSNK1A1, CTBP1, CTBP2, CTCF, CTF1, CTLA4, CTNNA1, CTNNA2, CTNNA3, CTNNB1, CUL1, CUL2, CXCL10, CXCL12, CXCL8, CXCR4, CYCS, CYLD.
D	DAPK1, DAPK2, DAPK3, DAPP1, DAXX, DBF4, DCC, DCLRE1C, DDIT3, DDIT4, DDX58, DHX58, DMAP1, DNMT3A, DOT1L, DPY30, DR1, DUSP1, DUSP10, DUSP16, DUSP2, DUSP3, DUSP4, DUSP5, DUSP6, DUSP7, DUSP8, DUSP9, DVL1, DVL2, DVL3.
E	E2F1, E2F2, E2F3, E2F4, E2F5, ECSIT, EDNRA, EDNRB, EED, EFNA1, EFNA2, EFNA3, EFNA4, EFNA5, EGF, EGFR, EGLN1, EGLN2, EGLN3, EHMT1, EHMT2, EIF4B, EIF4E, EIF4E1B, EIF4E2, EIF4EBP1, ELK1, ELK4, ELOB, ELOC, ELP2, ELP3, ELP4, ELP5, ELP6, ENY2, EP300, EP400, EPAS1, EPC1, EPHA2, EPO, EPOR, ERBB2, ERC1, ESPL1, ETS1, EZH2.

F	F2R, F2RL3, FADD, FAS, FASLG, FER, FGF1, FGF10, FGF11, FGF12, FGF13, FGF14, FGF16, FGF17, FGF18, FGF19, FGF2, FGF20, FGF21, FGF22, FGF23, FGF3, FGF4, FGF5, FGF6, FGF7, FGF8, FGF9, FGFR1, FGFR2, FGFR3, FGFR4, FH, FHL1, FLI1, FLNA, FLNB, FLNC, FLT1, FLT3, FLT3LG, FLT4, FN1, FOS, FOXO1, FOXO3, FOXP3, FYB, FYN, FZD1, FZD10, FZD2, FZD3, FZD4, FZD5, FZD6, FZD7, FZD8, FZD9, FZR1.
G	G6PC, G6PC2, G6PC3, GADD45A, GADD45B, GADD45G, GATA1, GATA2, GATA3, GATA6, GATAD2A, GATAD2B, GDF15, GFAP, GFI1B, GH1, GH2, GHR, GIMAP5, GLI1, GLI2, GLI3, GNA11, GNA12, GNA13, GNAI1, GNAI2, GNAI3, GNAL, GNAQ, GNAS, GNB1, GNB2, GNB3, GNB4, GNB5, GNG10, GNG11, GNG12, GNG13, GNG2, GNG3, GNG4, GNG5, GNG7, GNG8, GNGT1, GNGT2, GPS2, GPX1, GRAP2, GRB2, GRK6, GSK3B, GSTP1, GYS1, GYS2, GZMA, GZMB.
H	H2AFB1, H2AFJ, H2AFV, H2AFX, H2AFZ, HAT1, HAVCR1, HAVCR2, HCFC1, HCK, HCLS1, HDAC1, HDAC10, HDAC2, HDAC3, HDAC8, HGF, HHIP, HIF1A, HIST1H2AA, HIST1H2AB, HIST1H2AC, HIST1H2AD, HIST1H2AE, HIST1H2AG, HIST1H2AH, HIST1H2AI, HIST1H2AJ, HIST1H2AK, HIST1H2AL, HIST1H2AM, HIST1H2BA, HIST1H2BB, HIST1H2BC, HIST1H2BD, HIST1H2BE, HIST1H2BF, HIST1H2BG, HIST1H2BH, HIST1H2BI, HIST1H2BJ, HIST1H2BK, HIST1H2BL, HIST1H2BM, HIST1H2BN, HIST1H2BO, HIST1H3A, HIST1H3B, HIST1H3C, HIST1H3D, HIST1H3E, HIST1H3F, HIST1H3G, HIST1H3H, HIST1H3I, HIST1H3J, HIST1H4A, HIST1H4B, HIST1H4C, HIST1H4D, HIST1H4E, HIST1H4F, HIST1H4H, HIST1H4I, HIST1H4J, HIST1H4K, HIST1H4L, HIST2H2AA3, HIST2H2AA4, HIST2H2AB, HIST2H2AC, HIST2H2BE, HIST2H2BF, HIST2H3A, HIST2H3C, HIST2H3D, HIST2H4A, HIST2H4B, HIST3H2A, HIST3H2BB, HIST4H4, HLA-DMA, HLA-DMB, HLA-DOA, HLA-DOB, HLA-DPA1, HLA-DQA1, HLA-DQA2, HLA-DQB1, HLA-DRA, HLA-DRB1, HLA-DRB3, HLA-DRB4, HLA-DRB5, HMG20B, HMOX1, HRAS, HSP90AA1, HSP90AB1, HSP90B1, HSPA1A, HSPA1B, HSPA1L, HSPA2, HSPA6, HSPA8, HSPB1.
I	IBSP, ICAM2, ICOS, ID3, IDO1, IFI16, IFIH1, IFNA1, IFNA10, IFNA13, IFNA14, IFNA16, IFNA17, IFNA2, IFNA21, IFNA4, IFNA5, IFNA6, IFNA7, IFNA8, IFNAR1, IFNAR2, IFNB1, IFNE, IFNG, IFNGR1, IFNGR2, IFNK, IFNL1, IFNL2, IFNL3, IFNLR1, IFNW1, IGF1, IGF1R, IKBKAP, IKBKB, IKBKE, IKBKG, IKZF1, IKZF3, IL10, IL10RA, IL10RB, IL11, IL11RA, IL12A, IL12B, IL12RB1, IL12RB2, IL13, IL13RA1, IL13RA2, IL15, IL15RA, IL17D, IL19, IL1A, IL1B, IL1R1, IL1R2, IL1RN, IL2, IL20, IL20RA, IL20RB, IL21, IL21R, IL22, IL22RA1, IL22RA2, IL23A, IL23R, IL24, IL27RA, IL2RA, IL2RB, IL2RG, IL3, IL3RA, IL4, IL4R, IL5, IL5RA, IL6, IL6R, IL6ST, IL7, IL7R, IL9, IL9R, ING3, ING4, ING5, INPP5D, INPPL1, INS, INSR, IRAK1, IRAK2, IRAK3, IRAK4, IRF1, IRF2, IRF3, IRF4, IRF5, IRF6, IRF7, IRF8, IRF9, IRS1, ITCH, ITGA1, ITGA10, ITGA11, ITGA2, ITGA2B, ITGA3, ITGA4, ITGA5, ITGA6, ITGA7, ITGA8, ITGA9, ITGAV, ITGB1, ITGB3, ITGB4, ITGB5, ITGB6, ITGB7, ITGB8, ITK, ITPR1, ITPR2, ITPR3.
J	JADE1, JADE2, JADE3, JAK1, JAK2, JAK3, JMJD6, JMJD7-PLA2G4B, JUN, JUNB, JUND, JUP.
K	KANSL1, KANSL2, KANSL3, KAT14, KAT2A, KAT2B, KAT5, KAT6A, KAT6B, KAT7, KAT8, KDM1A, KDM1B, KDM2A, KDM2B, KDM3A, KDM3B, KDM4A, KDM4B, KDM4C, KDM4D, KDM5A, KDM5B, KDM5C, KDM5D, KDM6A, KDM6B, KDM7A, KDM8, KDR, KIT, KITLG, KLK3, KMT2A, KMT2B, KMT2C, KMT2D, KMT2E, KMT5A, KMT5B, KMT5C, KRAS.

L	LAG3, LAMA1, LAMA2, LAMA3, LAMA4, LAMA5, LAMB1, LAMB2, LAMB3, LAMB4, LAMC1, LAMC2, LAMC3, LAMTOR3, LAT, LAT2, LATS1, LCK, LCP1, LCP2, LEF1, LEP, LEPR, LGALS1, LGALS3, LIF, LIFR, LITAF, LOC102723407, LPAR1, LPAR2, LPAR3, LPAR4, LPAR5, LPAR6, LSP1, LYN.
M	MAD1L1, MAD2L1, MAD2L2, MALT1, MAP2K1, MAP2K2, MAP2K3, MAP2K4, MAP2K5, MAP2K6, MAP2K7, MAP3K1, MAP3K11, MAP3K12, MAP3K13, MAP3K14, MAP3K2, MAP3K3, MAP3K4, MAP3K5, MAP3K6, MAP3K7, MAP3K8, MAP4K1, MAP4K2, MAP4K3, MAP4K4, MAPK1, MAPK10, MAPK11, MAPK12, MAPK13, MAPK14, MAPK3, MAPK7, MAPK8, MAPK8IP1, MAPK8IP2, MAPK8IP3, MAPK9, MAPKAPK2, MAPKAPK3, MAPKAPK5, MAPT, MAVS, MAX, MBD3, MBIP, MCL1, MCM2, MCM3, MCM4, MCM5, MCM6, MCM7, MCRS1, MDM2, MEAF6, MECOM, MEF2C, MET, MINA, MIR1281, MIR555, MIR6755, MIR7107, MITF, MKL1, MKNK1, MKNK2, MLH1, MLST8, MME, MMP1, MMP2, MMP9, MNDA, MORF4L1, MORF4L2, MOS, MPL, MPO, MRAS, MRGBP, MSH2, MSH3, MSH6, MSL1, MSL2, MSL3, MTA1, MTA2, MTA3, MTCP1, MTOR, MYB, MYC, MYD88.
N	NCAM1, NCF1, NCF2, NCF4, NCK1, NCOA1, NCOA2, NCOA4, NCOR1, NCOR2, NDRG1, NF1, NFAT5, NFATC1, NFATC2, NFATC3, NFATC4, NFIL3, NFKB1, NFKB2, NFKBIA, NFKBIB, NFKBIE, NFKBIZ, NGF, NGFR, NKX3-1, NLK, NLRP1, NLRX1, NOD1, NOS2, NOS3, NQO1, NR1D1, NR4A1, NRAS, NSD1, NSD2, NSD3, NT5E, NTF3, NTF4, NTRK1, NTRK2.
O	OAS1, OGT, ORC1, ORC2, ORC3, ORC4, ORC5, ORC6, OSM, OSMR, OTUD5, OTUD7B, OTULIN.
P	PADI1, PADI2, PADI3, PADI4, PADI6, PAK1, PAK2, PAK3, PAK4, PAK5, PAK6, PAWR, PAX3, PAX5, PAX8, PBRM1, PBX1, PCK1, PCK2, PCNA, PDCD1, PDCD1LG2, PDGFA, PDGFB, PDGFC, PDGFD, PDGFRA, PDGFRB, PDLIM2, PDPK1, PECAM1, PELI1, PGF, PHF2, PHF20, PHF21A, PHF8, PHLPP1, PHLPP2, PIAS1, PIAS2, PIAS3, PIAS4, PIK3AP1, PIK3CA, PIK3CB, PIK3CD, PIK3CG, PIK3R1, PIK3R2, PIK3R3, PIK3R4, PIK3R5, PIM1, PIM2, PIM3, PIR, PKMYT1, PKN1, PKN2, PKN3, PLA2G4A, PLA2G4B, PLA2G4C, PLA2G4D, PLA2G4E, PLA2G4F, PLCB1, PLCB2, PLCB3, PLCB4, PLCG1, PLCG2, PLD1, PLEKHG5, PLK1, PML, POT1, PPARD, PPARG, PPIA, PPM1A, PPM1B, PPP2CA, PPP2CB, PPP2R1A, PPP2R1B, PPP2R2A, PPP2R2B, PPP2R2C, PPP2R2D, PPP2R3A, PPP2R3B, PPP2R3C, PPP2R5A, PPP2R5B, PPP2R5C, PPP2R5D, PPP2R5E, PPP3CA, PPP3CB, PPP3CC, PPP3R1, PPP3R2, PPP5C, PPP5D1, PRDM1, PRDM16, PRDM9, PRKAA1, PRKAA2, PRKACA, PRKACB, PRKACG, PRKCA, PRKCB, PRKCG, PRKCQ, PRKDC, PRKG1, PRL, PRLR, PRMT1, PRMT3, PRMT5, PRMT6, PRMT7, PSIP1, PSMB8, PTCH1, PTCH2, PTEN, PTGER1, PTGER2, PTGER3, PTGER4, PTGS1, PTGS2, PTK2, PTK2B, PTPN11, PTPN2, PTPN22, PTPN5, PTPN6, PTPN7, PTPRC, PTPRN2, PTPRR, PTTG1, PTTG2, PVR.
R	RABGEF1, RAC1, RAC2, RAC3, RAD21, RAD51, RAF1, RAG1, RALA, RALB, RALBP1, RALGDS, RAP1A, RAP1B, RAPGEF2, RARA, RARB, RASA1, RASA2, RASGRF1, RASGRF2, RASGRP1, RASGRP2, RASGRP3, RASGRP4, RASSF1, RASSF5, RB1, RBBP4, RBBP5, RBBP7, RBL1, RBL2, RBX1, RCOR1, REL, RELA, RELB, RELN, REST, RET, RFXAP, RHEB, RHOA, RIPK1, RIPK2, RIPK3, RIPK4, RLTPR, ROCK1, ROCK2, RPS2, RPS6, RPS6KA1, RPS6KA2, RPS6KA3, RPS6KA4, RPS6KA5, RPS6KA6, RPS6KB1, RPS6KB2, RPTOR, RRAS, RRAS2, RSAD2, RUNX1, RUNX1T1, RUVBL1, RUVBL2, RXRA, RXRB, RXRG.

S	SAP130, SAP18, SAP30, SAP30L, SARM1, SETD1A, SETD1B, SETD2, SETD3, SETD6, SETD7, SETDB1, SETDB2, SFN, SGF29, SGK1, SGK2, SGK3, SH2D1A, SH3KBP1, SHARPIN, SHH, SIRPA, SIT1, SIVA1, SKP1, SKP2, SLC2A1, SMAD2, SMAD3, SMAD4, SMARCA2, SMARCA4, SMARCB1, SMARCC1, SMARCC2, SMARCD1, SMARCD2, SMARCD3, SMARCE1, SMC1A, SMC1B, SMC3, SMO, SMYD2, SMYD3, SOCS1, SOCS2, SOCS3, SOCS4, SOCS5, SOCS6, SOCS7, SOS1, SOS2, SPI1, SPIB, SPP1, SRF, STAG1, STAG2, STAM, STAM2, STAT1, STAT2, STAT3, STAT4, STAT5A, STAT5B, STAT6, STK11, STK17B, STK3, STK36, STK4, STMN1, SUDS3, SUFU, SUPT20H, SUPT3H, SUPT7L, SUV39H1, SUV39H2, SUZ12, SWAP70, SYK.
T	TAB1, TAB2, TAB3, TADA1, TADA2A, TADA2B, TADA3, TAF10, TAF12, TAF5L, TAF6L, TAF9, TAL1, TANK, TAOK1, TAOK2, TAOK3, TAP1, TAP2, TAX1BP1, TBK1, TBKBP1, TBL1X, TBL1XR1, TBX21, TCF12, TCF3, TCF7, TCF7L1, TCF7L2, TCL1A, TCL1B, TEC, TEK, TET2, TFDP1, TFDP2, TFG, TGFA, TGFB1, TGFB2, TGFB3, TGFBR1, TGFBR2, THBS1, THBS2, THBS3, THBS4, THEM4, THEMIS, THPO, TICAM1, TLR1, TLR2, TLR3, TLR4, TLR6, TLR7, TLR8, TLR9, TNC, TNF, TNFAIP3, TNFRSF10B, TNFRSF10D, TNFRSF11A, TNFRSF12A, TNFRSF1A, TNFRSF1B, TNFRSF25, TNFRSF4, TNFSF11, TNFSF12, TNFSF13B, TNFSF15, TNFSF4, TNIP1, TNN, TNR, TNXB, TOLLIP, TP53, TPM3, TPR, TPT1, TRAF1, TRAF2, TRAF3, TRAF4, TRAF5, TRAF6, TRAT1, TRIB2, TRIM25, TRRAP, TSC1, TSC2, TSLP, TTK, TXN, TYK2, TYROBP.
U	U2AF1, UBE2N, USP15, USP22, UTY.
V	VAV1, VAV2, VAV3, VCAM1, VEGFA, VEGFB, VEGFC, VEGFD, VHL, VPS72, VSIR, VTCN1, VTN, VWF.
X	XIAP, XRCC5.
Y	YEATS2, YEATS4, YWHAB, YWHAE, YWHAG, YWHAH, YWHAQ, YWHAZ.
Z	ZAK, ZAP70, ZBTB16, ZBTB17, ZBTB7B, ZEB1, ZNF365, ZZZ3.

Supplementary table S7 compiles genes reported as mutated in CTCL (Park et al. 2017. Blood; 130:1430-1440) and genes involved in cellular processes/pathways known to be deregulated in CTCL (Bastidas Torres et al. 2018. Semin Cutan Med Surg; 37:81-86). Gene lists were retrieved from the PathCards database (http://pathcards.genecards.org/). PathCards gene lists: cell cycle, chromatin organization, JAK-STAT pathway, MAPK pathway, NF-κB pathway, PI-3-K/Akt pathway and TCR pathway.

Supplementary Table S8. Differentially expressed genes (FDR < 0.01) in pcAECyTCL when compared to skin-resident CD8+ T cells.

Gene	LogFC	Expression (mean)	*p*-value	FDR
RN7SL1	14.63145184	3.581419583	2.60E-16	3.03E-12
B2M	-2.419030785	13.12798277	2.03E-14	1.18E-10
RN7SL2	13.31997362	3.561272326	1.40E-13	4.97E-10
LCK	-3.992852283	9.767951238	1.71E-13	4.97E-10
IGFBP7	4.768223967	4.817506416	6.89E-12	1.60E-08
PRRC2A	4.554023774	5.043193429	1.23E-11	2.38E-08
MYL12A	-2.360383827	9.432009647	1.51E-11	2.50E-08
SCARNA21	5.382217801	1.308927565	1.78E-11	2.59E-08
LOC104968399	-2.467285025	8.560108609	2.55E-11	3.29E-08
LINC01000	3.594101878	5.906854702	7.66E-11	8.90E-08
SRP14	-2.616974368	7.5515466	9.87E-11	1.04E-07
MAPKAPK2	4.865927344	3.873398365	1.45E-10	1.34E-07
SKP1	-2.139780881	8.248794662	1.50E-10	1.34E-07
SH3BGRL3	-2.125458736	9.298143428	2.35E-10	1.95E-07
HIST1H1C	5.313770825	4.816604599	3.44E-10	2.67E-07
SORL1	-3.322240912	9.27771339	4.21E-10	2.85E-07
CMIP	4.985336537	3.399466971	4.79E-10	2.85E-07
SELPLG	-2.752306307	9.18617147	4.87E-10	2.85E-07
CST3	9.635169206	2.199733135	4.94E-10	2.85E-07
ARL6IP5	-2.300692801	8.646467679	5.08E-10	2.85E-07
GIMAP7	-4.357066653	8.68273098	5.15E-10	2.85E-07
KLF13	3.192286055	6.48903527	6.56E-10	3.46E-07
TNS2	6.609373497	1.336217116	1.09E-09	5.40E-07
SRCAP	2.468656753	6.348724837	1.11E-09	5.40E-07
KMT2D	3.837575871	6.126999581	1.21E-09	5.61E-07
HLA-E	-2.165573326	11.95644054	1.28E-09	5.61E-07
CALR	2.739259169	7.232302062	1.30E-09	5.61E-07
ZC3H7B	4.928837335	3.924910356	1.54E-09	6.41E-07
HCFC1	3.574822427	5.667294793	2.09E-09	8.22E-07
CTSB	2.868495457	8.468468903	2.12E-09	8.22E-07
QKI	3.289359592	5.706040811	2.82E-09	1.02E-06
ATP2A2	3.622299992	6.094195161	2.86E-09	1.02E-06
IL16	-2.131403406	9.123511185	2.97E-09	1.02E-06
YWHAG	4.257481441	4.609180912	2.99E-09	1.02E-06
DGKA	-2.499857449	8.364063168	3.53E-09	1.17E-06
GAS7	5.14765957	4.680043633	4.01E-09	1.27E-06
AKNA	2.419302697	7.508447918	4.04E-09	1.27E-06
PPP2R4	3.489687652	4.702481843	4.55E-09	1.39E-06
ADGRA2	5.089008246	3.194731371	5.28E-09	1.57E-06
PRKDC	2.154959963	7.712073701	5.43E-09	1.58E-06
CALM2	-1.579164017	8.843621155	6.16E-09	1.74E-06
PSMB8-AS1	-1.948227806	8.119662457	6.30E-09	1.74E-06
MIDN	4.211723495	4.266497962	6.77E-09	1.83E-06
ARHGDIB	-2.397813471	10.30968882	6.98E-09	1.84E-06
CD3D	-2.775423806	7.913909664	7.80E-09	2.01E-06
MYL12B	-1.598052757	8.601550002	8.04E-09	2.03E-06
HIST1H2AM	7.715651207	1.037954081	8.57E-09	2.12E-06
HIST1H2BC	7.395388104	1.450476059	9.14E-09	2.20E-06
DDX17	1.771523024	8.240229709	9.30E-09	2.20E-06
FN1	9.185068827	2.473736775	1.06E-08	2.45E-06

A2M	5.958214488	6.080078374	1.09E-08	2.47E-06
NFE2L1	2.655109879	5.961997984	1.15E-08	2.58E-06
ATP6V0E1	-1.912544261	7.202401378	1.18E-08	2.58E-06
KMT2B	2.919689485	5.013503422	1.27E-08	2.70E-06
AEBP1	9.011286247	2.072130584	1.29E-08	2.70E-06
GIGYF1	3.17159934	5.389364028	1.30E-08	2.70E-06
ITK	-2.735901399	8.98123984	1.38E-08	2.81E-06
DYNC1H1	1.916899161	8.601011806	1.42E-08	2.85E-06
ACTN4	2.819817918	6.850332649	1.51E-08	2.97E-06
GSTK1	-1.830289231	8.413976624	1.57E-08	3.05E-06
SPRY1	7.45185985	1.172993723	1.62E-08	3.09E-06
CD53	-2.001806209	9.242562959	1.82E-08	3.41E-06
SPAG9	2.159022731	6.272245223	1.90E-08	3.47E-06
DDX5	-2.349223326	11.43497079	1.91E-08	3.47E-06
NFIC	3.467807932	4.410882133	1.97E-08	3.52E-06
LENG8	5.073961034	4.380060329	2.11E-08	3.71E-06
LASP1	1.896289843	7.59378145	2.27E-08	3.94E-06
TRRAP	2.607644013	6.911200086	2.33E-08	3.97E-06
IFITM3	4.052843427	4.49619561	2.41E-08	4.02E-06
RPL36AL	-1.886728428	7.265414572	2.42E-08	4.02E-06
EP400	2.433051834	6.09511131	2.73E-08	4.40E-06
NFAT5	3.064006071	6.07002318	2.74E-08	4.40E-06
CNBP	-1.660505837	9.179922119	2.76E-08	4.40E-06
RAD23B	2.826077204	5.381222877	2.81E-08	4.42E-06
TRAF3IP3	-2.270070389	8.238129463	2.87E-08	4.45E-06
C9orf78	-2.726921292	7.485871223	3.02E-08	4.61E-06
CTSZ	6.177264727	2.580102192	3.21E-08	4.85E-06
TET3	3.775266901	4.536990295	3.35E-08	4.99E-06
BEX2	-5.576764399	3.58957966	3.66E-08	5.39E-06
RREB1	2.728756255	5.29370386	3.92E-08	5.69E-06
SERPINF1	8.198208963	2.521637847	4.03E-08	5.78E-06
GIMAP4	-2.95394915	8.982665703	4.12E-08	5.84E-06
HLA-DRA	4.709746432	7.363346345	4.25E-08	5.95E-06
TNPO2	2.792898622	4.908597868	4.74E-08	6.56E-06
PRR12	5.338824641	2.462047262	4.82E-08	6.59E-06
IL7R	-4.046575519	10.36117572	5.15E-08	6.95E-06
IRF2BPL	3.199603235	4.550178772	5.39E-08	7.20E-06
ARF3	2.560035892	6.135477867	5.91E-08	7.81E-06
HECTD4	2.260984188	6.323938335	6.17E-08	8.01E-06
U2AF2	4.99230301	3.102255652	6.22E-08	8.01E-06
HLA-DQA1	5.424669033	4.59869498	6.27E-08	8.01E-06
ZFP36L1	2.63897758	6.637356713	6.37E-08	8.04E-06
AP1G2	-2.1342434	8.375407072	6.51E-08	8.13E-06
AHR	2.656912132	6.370700441	7.40E-08	9.14E-06
C15orf39	3.521314159	5.033941331	7.48E-08	9.15E-06
MAT2B	-2.550479647	8.118914598	7.59E-08	9.19E-06
DAZAP2	-1.986486631	9.20058377	8.52E-08	1.02E-05
TMEM59	-1.716332249	7.878052773	8.65E-08	1.03E-05
SCARNA17	4.700230123	2.795231563	9.13E-08	1.07E-05
AHNAK	2.597245211	10.80607885	9.52E-08	1.11E-05
SCARB2	3.06789613	5.283297132	1.04E-07	1.18E-05
CD81	2.902054997	6.438090417	1.05E-07	1.18E-05
DNAJC8	-2.515882471	7.167195766	1.05E-07	1.18E-05
LAMP1	3.584595806	5.265481476	1.08E-07	1.21E-05
IL2RG	-2.57484095	9.713840229	1.10E-07	1.22E-05

LRP1	7.700838173	4.012107475	1.11E-07	1.22E-05
PFDN5	-1.964638474	7.94433583	1.12E-07	1.22E-05
DLST	2.912463182	4.947723191	1.14E-07	1.23E-05
MTRNR2L2	-4.668655155	0.139446825	1.17E-07	1.24E-05
HIST1H2AC	4.082251341	4.020155264	1.29E-07	1.36E-05
LOC100996286	-5.428412177	5.30692546	1.32E-07	1.38E-05
PAIP2	-2.475518422	7.812911816	1.39E-07	1.44E-05
KSR1	5.720417552	2.257055338	1.40E-07	1.44E-05
VPS13C	1.949856586	8.05834547	1.53E-07	1.56E-05
LPP	3.070178421	6.282861425	1.57E-07	1.59E-05
TCF7	-2.864638588	7.798580936	1.60E-07	1.61E-05
HIST1H2BD	6.497314509	2.209342587	1.62E-07	1.61E-05
SOD1	-2.211404372	7.327049333	1.65E-07	1.62E-05
IGFBP4	8.988285398	2.61853074	1.70E-07	1.66E-05
NUFIP2	2.29049923	6.785219424	1.77E-07	1.71E-05
DAZAP1	3.658209382	3.977066289	1.81E-07	1.74E-05
CD74	2.580092248	10.02949632	1.95E-07	1.86E-05
ZFYVE26	4.945868375	3.84563774	2.01E-07	1.90E-05
DMXL1	2.445691493	5.658980593	2.06E-07	1.93E-05
RAB12	4.947156603	1.728958898	2.11E-07	1.96E-05
TXNIP	-1.963480228	11.19566018	2.12E-07	1.96E-05
CASP8	-2.150941802	8.013888942	2.18E-07	1.99E-05
TNRC18	5.915296648	3.687403509	2.19E-07	1.99E-05
NEAT1	3.726659566	9.553305343	2.21E-07	1.99E-05
MED13L	2.626293541	6.131352271	2.28E-07	2.04E-05
DTX4	6.603533051	1.22983658	2.30E-07	2.04E-05
HIST1H1D	4.930975921	4.065905408	2.31E-07	2.04E-05
MACF1	1.712421474	9.187990945	2.34E-07	2.04E-05
COL6A1	8.274297918	3.87569969	2.44E-07	2.12E-05
ACIN1	1.553322576	6.333251038	2.50E-07	2.15E-05
RFX1	5.189974364	0.690841277	2.84E-07	2.43E-05
GPR107	2.604537138	5.161163229	2.91E-07	2.47E-05
DHRS7	-2.995684861	7.128468974	3.02E-07	2.54E-05
CIC	6.50315626	2.586180301	3.09E-07	2.58E-05
C1RL-AS1	3.62000293	4.154387056	3.14E-07	2.61E-05
ANXA1	-2.031795025	9.333915443	3.18E-07	2.62E-05
BRCA1	6.738697949	1.504310862	3.40E-07	2.78E-05
WDR86-AS1	-4.563929526	3.267563144	3.42E-07	2.78E-05
SOD2	2.448293515	6.940643875	3.44E-07	2.78E-05
SRSF7	-1.802702315	8.283806647	3.51E-07	2.82E-05
ANAPC16	-1.572000094	7.303671708	3.57E-07	2.83E-05
PSMB8	-1.745465746	8.021684966	3.58E-07	2.83E-05
CCR7	-4.551793876	8.017261614	3.65E-07	2.87E-05
SLC7A1	2.880422068	5.219159354	3.67E-07	2.87E-05
TAOK1	1.908663016	6.453026547	3.72E-07	2.87E-05
HIST1H1E	3.606146312	5.708362226	3.74E-07	2.87E-05
LSM14B	4.371561623	2.379503041	3.80E-07	2.91E-05
MYD88	-1.681658406	7.933069969	3.87E-07	2.94E-05
CENPB	5.888900934	2.280778557	3.90E-07	2.94E-05
HUWE1	2.204169357	8.23255432	3.95E-07	2.95E-05
SH3KBP1	-1.333118754	7.94162275	3.96E-07	2.95E-05
COX4I1	-1.649738866	7.859128096	3.99E-07	2.95E-05
BAG6	2.772094834	5.411983409	4.02E-07	2.96E-05
KIAA1551	-2.499754294	9.760200857	4.05E-07	2.96E-05
DYNLL2	5.668075896	1.507412887	4.09E-07	2.97E-05

FYB	-2.060881174	8.988332371	4.28E-07	3.09E-05
ARHGAP15	-1.764021237	7.65017989	4.41E-07	3.16E-05
HMOX2	-2.282898901	7.384622918	4.43E-07	3.16E-05
CHMP4B	5.629265439	1.578084883	4.84E-07	3.43E-05
EPAS1	5.119594003	2.847723605	4.92E-07	3.46E-05
SKI	5.617991945	3.126684903	5.02E-07	3.50E-05
POLR1A	3.313523913	4.767398282	5.03E-07	3.50E-05
CDK12	2.357929672	5.807929665	5.29E-07	3.64E-05
NF1	2.258157093	5.862150485	5.30E-07	3.64E-05
ARF1	-1.468844699	9.07024871	5.32E-07	3.64E-05
FGL2	7.971725588	2.378435035	5.39E-07	3.66E-05
TRIM41	3.818832125	3.097864283	5.47E-07	3.69E-05
COL18A1	7.188931241	2.989018339	5.49E-07	3.69E-05
PLXNB2	6.808218698	2.164730509	5.53E-07	3.69E-05
YWHAB	-1.948431395	9.513082425	5.80E-07	3.85E-05
PICALM	1.606646702	6.831954501	5.99E-07	3.96E-05
SETD1B	2.316387779	5.015676037	6.23E-07	4.09E-05
NOTCH2	2.783898169	6.738906882	6.48E-07	4.23E-05
REV3L	1.604960528	6.586062204	6.60E-07	4.28E-05
ZNF687	4.470402262	2.965246123	6.72E-07	4.30E-05
ZEB2	7.602610562	4.332589479	6.73E-07	4.30E-05
CD59	2.244067157	6.816256968	6.73E-07	4.30E-05
ATN1	5.340981423	3.029321163	6.93E-07	4.38E-05
SLC35F5	3.765703218	4.169134359	6.94E-07	4.38E-05
NRROS	6.032152099	0.756214205	7.49E-07	4.71E-05
PIK3C2B	2.369544919	5.002137694	7.71E-07	4.81E-05
CELF2-AS1	5.976299343	1.875343744	8.06E-07	5.01E-05
SNX8	6.615732325	1.228340703	8.19E-07	5.06E-05
HINT1	-1.460652548	7.490338604	8.69E-07	5.34E-05
EIF1	-1.698983013	9.554931156	8.87E-07	5.42E-05
ZNF609	3.018227655	4.723026695	9.10E-07	5.53E-05
KIAA0368	1.870000177	6.692245595	9.13E-07	5.53E-05
TRIM25	2.582262767	5.694854772	9.24E-07	5.55E-05
PLEKHG1	7.282115647	1.326894333	9.27E-07	5.55E-05
PAPLN	6.285637068	1.609648757	9.36E-07	5.58E-05
ZNF787	4.898164633	0.958737179	9.41E-07	5.58E-05
UBN2	2.665224942	4.75042047	9.51E-07	5.60E-05
ATP6V1G1	-2.153563448	7.166788397	9.54E-07	5.60E-05
GNL3L	1.721304674	6.380962929	9.64E-07	5.63E-05
LOC102724814	-2.127658772	7.525889738	1.01E-06	5.85E-05
CIITA	7.540274612	2.643320067	1.02E-06	5.85E-05
UGGT1	1.852445927	6.620236347	1.02E-06	5.85E-05
SEPP1	8.071692076	3.59716207	1.02E-06	5.85E-05
HIST1H2BK	3.222396815	4.776899293	1.04E-06	5.92E-05
C1RL	2.621718449	4.198916415	1.05E-06	5.97E-05
LGMN	4.909724545	4.419143093	1.06E-06	5.97E-05
GRINA	5.917775254	2.390241993	1.08E-06	6.05E-05
TAP2	1.721145755	6.613577413	1.08E-06	6.05E-05
HMGN4	-2.104454357	7.758857741	1.11E-06	6.15E-05
ADGRE2	5.127909756	1.236313312	1.11E-06	6.15E-05
RPL23A	-1.475209827	7.962159389	1.12E-06	6.16E-05
CEMIP	5.716826214	2.063221258	1.13E-06	6.17E-05
IFITM1	-2.761901325	9.208426673	1.13E-06	6.19E-05
PTMS	6.009787427	1.58760085	1.14E-06	6.21E-05
GSN	6.302500147	4.627665885	1.16E-06	6.27E-05

INO80E	3.854007826	2.632727414	1.23E-06	6.62E-05
VPS13A	1.769260052	6.251969037	1.24E-06	6.63E-05
DNAJB2	3.361017513	3.28225199	1.26E-06	6.67E-05
APP	6.764706067	2.809765832	1.26E-06	6.67E-05
ZMIZ2	2.642617462	5.389663477	1.26E-06	6.67E-05
PCOLCE	5.018255568	2.539521993	1.27E-06	6.67E-05
CD2	-4.425777029	7.935839973	1.30E-06	6.83E-05
H3F3B	-1.525782428	9.973826533	1.32E-06	6.86E-05
TTYH3	6.822896586	2.812392851	1.34E-06	6.96E-05
AHDC1	4.684116761	2.398692125	1.37E-06	7.07E-05
CCDC50	6.297341351	1.822669665	1.40E-06	7.18E-05
RUNX1	2.399010807	6.234706183	1.41E-06	7.18E-05
SYNGAP1	4.374588831	1.734026353	1.41E-06	7.18E-05
FKBP1A	2.431419943	5.559857861	1.41E-06	7.18E-05
ITPR2	1.841517512	6.812306786	1.47E-06	7.43E-05
PARK7	-1.440471466	7.29571378	1.56E-06	7.85E-05
ATG2B	1.997205069	5.729643211	1.57E-06	7.85E-05
EZR	-1.561351301	9.445233397	1.57E-06	7.85E-05
CELSR1	7.476853064	1.228213092	1.60E-06	7.96E-05
SARAF	-2.973533252	9.788763546	1.63E-06	8.05E-05
SRSF5	-1.289281062	8.565171999	1.64E-06	8.05E-05
PCED1B-AS1	-2.77715888	6.832084457	1.64E-06	8.05E-05
SYNE3	4.889666298	2.848172628	1.66E-06	8.12E-05
B4GALT5	3.731937363	4.307416522	1.70E-06	8.26E-05
PRPF19	3.827380975	3.665060803	1.71E-06	8.27E-05
AFF4	2.298828125	6.295002108	1.72E-06	8.29E-05
RPL37	1.548278863	6.897059681	1.76E-06	8.41E-05
STK38	-1.878949624	7.957238167	1.76E-06	8.41E-05
BUB3	-1.568521703	8.172910517	1.81E-06	8.64E-05
TLE3	2.120473549	5.968988639	1.84E-06	8.70E-05
HELZ2	4.323000107	4.291515667	1.87E-06	8.83E-05
PPP1R9B	4.95052236	3.803136842	1.88E-06	8.84E-05
FAM168A	2.880061088	5.087198859	1.92E-06	8.97E-05
SYVN1	1.982065416	4.907554445	1.94E-06	9.07E-05
ITGAV	5.543927535	4.020012214	1.95E-06	9.07E-05
SSFA2	3.127664387	5.270404644	1.98E-06	9.12E-05
SCAF1	4.159683289	3.12584453	1.98E-06	9.12E-05
CTDSP1	2.241903361	5.629246885	1.99E-06	9.12E-05
M6PR	-1.546391012	7.975425833	2.00E-06	9.12E-05
PHF14	1.797274658	5.196319887	2.01E-06	9.12E-05
HAVCR2	7.002085857	2.068428913	2.01E-06	9.12E-05
SMG1	1.664858686	7.661430977	2.03E-06	9.16E-05
GPR183	-3.733304503	8.293261915	2.05E-06	9.23E-05
NECAP2	-1.322275199	7.545466286	2.06E-06	9.25E-05
ARHGEF3	-2.274191527	8.028802002	2.08E-06	9.31E-05
MFNG	-2.583476888	7.80574613	2.13E-06	9.48E-05
PBX2	5.28012953	2.366523472	2.14E-06	9.49E-05
IL10RA	-2.146157388	9.572475288	2.16E-06	9.56E-05
WDR6	-2.104090624	8.639639346	2.20E-06	9.67E-05
FOXRED2	5.416629069	0.702168557	2.25E-06	9.86E-05
LIMK1	4.627327102	3.839386677	2.26E-06	9.89E-05
SH2B1	3.146491542	3.575756139	2.27E-06	9.89E-05
WDTC1	3.286924904	3.999343883	2.34E-06	0.000101
PRR13	-1.801603315	7.139929304	2.34E-06	0.000101
CRYBG3	2.634237076	5.050533011	2.37E-06	0.000102

DAXX	-2.349190456	7.808980723	2.38E-06	0.000102
GM2A	3.11564987	4.954225788	2.39E-06	0.000102
PHOSPHO1	6.217627287	1.427218635	2.44E-06	0.000104
SH2D1A	-4.23715897	6.476291234	2.55E-06	0.000108
TMEM176B	6.043804201	1.166063337	2.57E-06	0.000109
MAF	3.390711989	5.523712099	2.64E-06	0.000111
FMNL2	6.608434887	2.152271078	2.70E-06	0.000113
UBR5	1.667393841	7.38637235	2.70E-06	0.000113
SPCS1	-2.695282273	6.943137994	2.75E-06	0.000115
ARHGAP25	-2.033856591	8.070637771	2.76E-06	0.000115
FASN	8.125648137	2.509457715	2.84E-06	0.000117
ZBED6	6.744320472	2.183015666	2.84E-06	0.000117
SPEN	1.512701321	7.041568441	2.86E-06	0.000117
GNB4	5.791987415	1.87745968	2.88E-06	0.000117
MBD6	4.895147459	2.618973398	2.88E-06	0.000117
DYRK1A	2.647981826	5.206429973	2.98E-06	0.000121
BRI3	4.109854173	2.591526009	3.00E-06	0.000121
PRKACA	4.08079096	2.981706607	3.01E-06	0.000121
ADAM9	6.128012577	1.748362659	3.01E-06	0.000121
LOC643733	-3.443039711	4.087649147	3.01E-06	0.000121
SNX29	1.972523361	5.382473486	3.04E-06	0.000121
MYO5A	1.767667395	6.750889843	3.05E-06	0.000121
MRFAP1L1	-2.505968906	7.440275871	3.10E-06	0.000123
G6PD	4.292302086	2.988077236	3.12E-06	0.000123
HIST2H2BE	7.377040618	2.046911919	3.14E-06	0.000123
NDUFB8	-2.137529822	7.053374201	3.15E-06	0.000123
TAGLN	5.582822777	1.296639101	3.15E-06	0.000123
KHSRP	4.641436665	3.371008983	3.18E-06	0.000124
SCAMP3	-1.66856598	6.728098019	3.18E-06	0.000124
SYF2	-2.415496869	6.155925733	3.20E-06	0.000124
PSMB9	-2.118337493	7.500091196	3.20E-06	0.000124
AKAP11	1.697991216	6.198820806	3.23E-06	0.000124
HNRNPL	2.299561779	5.983627567	3.24E-06	0.000124
FAM65A	3.163931231	4.522801481	3.30E-06	0.000126
RPS24	1.413575409	7.2758045	3.30E-06	0.000126
ZC3H4	2.80610968	5.050249261	3.34E-06	0.000126
ARHGEF12	3.955125315	4.92125185	3.34E-06	0.000126
PTPN11	1.620477072	6.705189266	3.36E-06	0.000127
ANKRD52	3.961495129	4.373590242	3.43E-06	0.000129
BMPR2	1.911792129	5.827674147	3.48E-06	0.00013
BCAP31	-1.269994533	7.753906641	3.51E-06	0.000131
PSME1	-1.419857216	8.184956821	3.54E-06	0.000132
FAM49A	6.55946527	1.595251882	3.57E-06	0.000132
CTSH	2.874417413	5.047789075	3.60E-06	0.000133
KDM2A	1.799670093	6.895471237	3.62E-06	0.000133
CLN6	6.01076972	1.477579039	3.69E-06	0.000136
TYROBP	3.712977393	3.885980957	3.80E-06	0.000139
CRIM1	2.835551756	5.082343834	3.81E-06	0.000139
KIAA0930	3.144141592	4.75806226	3.89E-06	0.000142
CTSK	4.301188818	4.623021876	3.94E-06	0.000143
IK	-2.445695729	7.408745179	3.96E-06	0.000143
CREBBP	1.55589348	6.763238301	4.17E-06	0.000151
SBNO2	5.546725007	3.628734144	4.19E-06	0.000151
PPP3R1	3.922560047	3.704827916	4.23E-06	0.000152
APRT	-1.577098462	7.284779307	4.36E-06	0.000156

PPFIBP1	6.369159092	2.179771443	4.38E-06	0.000156
ZMIZ1	3.623933083	5.113708499	4.40E-06	0.000156
BTN3A1	-2.091480703	8.191125998	4.41E-06	0.000156
YES1	6.735148858	1.686858532	4.44E-06	0.000157
MAP2K7	4.928895912	1.675797278	4.48E-06	0.000158
OTUD7B	5.175366629	2.58131718	4.50E-06	0.000158
LARP1	1.772350619	7.22818543	4.57E-06	0.00016
MAP4K1	-1.946750861	7.485535574	4.58E-06	0.00016
TUBA4A	-2.604967524	8.185519542	4.67E-06	0.000162
MNT	4.277866876	1.868096618	4.77E-06	0.000165
CD52	-3.397381605	8.378688547	4.78E-06	0.000165
GHITM	-1.460602709	8.144838484	4.79E-06	0.000165
RBM15	2.114750286	5.150502015	4.95E-06	0.00017
SRP9	-1.497246831	7.552595819	4.97E-06	0.00017
SNORA48	5.290342371	0.708023549	5.03E-06	0.000172
TCF20	2.110301551	5.372038484	5.06E-06	0.000172
PABPN1	5.190521976	0.326306986	5.12E-06	0.000174
SARS	-1.74401668	8.143981386	5.15E-06	0.000174
CABIN1	2.568012456	5.449479028	5.18E-06	0.000175
DMXL2	6.844953946	2.53291423	5.21E-06	0.000175
HEG1	1.984456264	6.802997135	5.21E-06	0.000175
MLLT4	5.942090023	3.372258444	5.22E-06	0.000175
MKL1	2.092692356	5.264063636	5.25E-06	0.000175
ALDH2	7.053015115	1.473500028	5.30E-06	0.000177
TGFB3	6.16058147	1.466760664	5.38E-06	0.000179
MRC2	6.354021122	1.906457458	5.42E-06	0.000179
DALRD3	-2.092264957	6.663776819	5.48E-06	0.000181
NAP1L4	-1.722574073	8.358434094	5.51E-06	0.000181
EMC10	3.040739974	3.885639805	5.59E-06	0.000183
TAF15	2.072536718	5.894770445	5.60E-06	0.000183
SMARCD1	2.863347715	4.264945246	5.62E-06	0.000183
RPS17	1.310495058	7.234865998	5.75E-06	0.000187
SIK2	4.655746321	2.142041392	5.76E-06	0.000187
SELT	-1.75782141	7.000564735	5.76E-06	0.000187
WWTR1	5.706585952	1.033094225	5.80E-06	0.000187
FAM107B	-2.221687361	8.08907469	5.82E-06	0.000187
GLIPR1	-2.524791056	7.948102474	5.89E-06	0.000189
RDH11	-2.275189614	6.908852221	5.94E-06	0.00019
MFAP4	6.093751416	0.994918274	5.98E-06	0.000191
UBE2D3	-1.188567861	9.010175962	6.11E-06	0.000194
KANSL1L	3.18722312	3.430184613	6.12E-06	0.000194
CCNDBP1	-2.386373108	7.401343161	6.14E-06	0.000194
PAG1	-1.591423021	7.997498358	6.24E-06	0.000197
TGFBI	6.309082187	3.284638989	6.35E-06	0.0002
SDR39U1	-2.076391477	6.79387477	6.46E-06	0.000203
ZNF460	5.061721083	3.18953703	6.50E-06	0.000203
TTC28	4.682600634	2.423002589	6.57E-06	0.000205
RPN1	-1.121901329	8.40776476	6.60E-06	0.000206
ARHGEF2	2.292600993	5.309472699	6.68E-06	0.000208
POTEE	3.181159162	3.445844545	6.72E-06	0.000208
SNX17	-1.418859851	7.876133043	6.94E-06	0.000214
OSBPL5	6.852294062	2.273502854	6.96E-06	0.000214
PSMC5	-1.695105239	7.66783471	7.12E-06	0.000219
FCHO2	6.144894853	1.678408566	7.13E-06	0.000219
SCAMP2	-1.712818802	7.37127145	7.47E-06	0.000228

NCOA2	2.202598887	5.846077562	7.57E-06	0.000231
SLC44A2	-1.642615032	7.739882183	7.59E-06	0.000231
UBXN11	-2.834589364	7.515978356	7.61E-06	0.000231
USP22	1.530458636	7.071343322	7.85E-06	0.000237
KLF16	5.068240964	1.252661063	7.87E-06	0.000237
DICER1	2.632390154	6.095148431	7.91E-06	0.000238
PHC1	-2.190441409	6.5265483	8.00E-06	0.00024
RAB1B	2.488166638	5.415292572	8.06E-06	0.000241
FANCC	6.342003764	1.559530808	8.26E-06	0.000247
KIF1B	1.766210583	6.042205979	8.30E-06	0.000247
LAT	-2.271788206	7.829474843	8.35E-06	0.000248
RCC2	1.570787837	6.884962138	8.43E-06	0.00025
NUP153	2.508430409	5.806613526	8.49E-06	0.000251
FBXW8	4.943332516	3.350689785	8.66E-06	0.000256
LLGL1	2.891655853	3.668779632	8.74E-06	0.000257
TRAT1	-3.868324492	7.041446186	8.75E-06	0.000257
CPM	5.893211039	1.398555415	8.83E-06	0.000259
TRPS1	6.239839373	3.29381669	8.88E-06	0.000259
PLEKHA2	1.69213839	6.454582807	8.90E-06	0.000259
MDH1	-1.388813484	7.324549474	8.92E-06	0.000259
DGKH	2.014560422	5.287852863	9.26E-06	0.000267
NSD1	1.77281221	7.043869251	9.34E-06	0.000267
AMZ2	-2.046324609	6.888850156	9.34E-06	0.000267
H2AFX	5.877052786	2.196143653	9.34E-06	0.000267
CACNA1C	4.562647097	2.688147255	9.34E-06	0.000267
SPOP	-1.892780082	6.931784413	9.34E-06	0.000267
RPL6	1.144181875	6.88588527	9.42E-06	0.000269
ZMYM6NB	-2.63372532	6.010897175	9.50E-06	0.00027
ECH1	-2.076848351	7.831757684	9.66E-06	0.000274
EGR1	6.912056226	2.555979014	9.71E-06	0.000275
TAF7	-2.107985136	7.620512354	9.79E-06	0.000277
C11orf58	-1.271399644	7.498841272	9.94E-06	0.00028
SULF2	6.13876449	1.479202682	9.96E-06	0.00028
CORO1B	3.518308108	3.136144638	9.98E-06	0.00028
VAMP8	-1.403575367	6.659403304	1.01E-05	0.000283
ANAPC2	4.852848282	1.972972562	1.02E-05	0.000284
HOOK3	1.372230096	6.248807428	1.02E-05	0.000285
ARPC5	-1.365584064	8.318280177	1.04E-05	0.000289
DUSP6	7.049250099	2.050911529	1.05E-05	0.000291
ZZEF1	1.964328316	6.786269633	1.05E-05	0.000292
MGLL	5.811079137	2.232661161	1.06E-05	0.000293
CD96	-2.049247814	8.589056543	1.07E-05	0.000294
PLCG2	5.736082395	4.353904358	1.07E-05	0.000294
TMEM50A	-1.429185391	7.56803635	1.07E-05	0.000294
PPP1R37	5.405873577	1.287792848	1.07E-05	0.000294
PLXNA1	5.340949632	2.965669994	1.08E-05	0.000294
RECQL4	6.006174648	1.456455938	1.08E-05	0.000294
KMT2C	1.662563317	8.217129987	1.08E-05	0.000295
ANAPC5	-1.232182284	8.259484712	1.09E-05	0.000296
HLA-DRB1	3.896365378	7.160147098	1.10E-05	0.000298
SAP18	-1.89943111	6.888498799	1.11E-05	0.000298
EPT1	2.939555942	4.707431581	1.12E-05	0.0003
CEBPD	6.397611799	2.958100937	1.12E-05	0.0003
FRMD4A	4.403394701	2.724447053	1.12E-05	0.000301
PUF60	-1.522975034	7.634381353	1.13E-05	0.000301

YBX3P1	5.034340678	0.353799515	1.13E-05	0.000301
LUC7L2	4.216005359	1.440429589	1.14E-05	0.000302
GABARAPL2	-1.690058519	6.762079436	1.14E-05	0.000302
SEPT6	-1.415721361	8.441108741	1.16E-05	0.000307
ARFGEF2	1.516784036	6.29537619	1.21E-05	0.000318
RPTOR	4.195477412	4.041469675	1.21E-05	0.000318
LRBA	1.58658315	7.459699502	1.22E-05	0.00032
CARM1	3.461701922	2.718873439	1.22E-05	0.00032
LYN	6.681809088	2.250839736	1.22E-05	0.00032
CDC26	-3.347274992	4.375340387	1.23E-05	0.000322
FAM196B	5.343121305	1.005312121	1.25E-05	0.000325
ASF1A	-2.068724427	6.684518763	1.25E-05	0.000325
BIN2	-2.106216155	7.987894063	1.26E-05	0.000328
ATXN2L	2.628194367	5.712367137	1.28E-05	0.00033
CCR1	6.883219068	2.616379427	1.28E-05	0.000331
IFITM2	-2.476947965	8.330679978	1.29E-05	0.000333
UGP2	-1.434729381	7.64975852	1.31E-05	0.000336
KIAA0754	5.748295559	1.460202094	1.31E-05	0.000336
LIMS1	1.714017757	5.750216	1.32E-05	0.000337
C11orf84	5.130335798	0.515769616	1.33E-05	0.000339
UHRF1	3.29864202	2.964736304	1.34E-05	0.000342
EIF4A2	-1.776530785	8.905135623	1.35E-05	0.000344
DDX24	-1.693022988	8.271763678	1.37E-05	0.000347
PTPN14	6.151221412	2.034768541	1.37E-05	0.000347
PPP1R18	1.563771597	6.625719944	1.38E-05	0.00035
COPS6	-1.462124546	7.019696748	1.39E-05	0.00035
HMGB1	-1.196211896	8.157287722	1.42E-05	0.000356
PEAK1	6.013814069	4.009008596	1.43E-05	0.000358
TMEM164	3.150372547	4.305154073	1.43E-05	0.000358
MESDC1	4.334941604	2.945333318	1.44E-05	0.000359
FAM120A	1.873836153	6.741037908	1.44E-05	0.000359
SPTLC2	2.224331868	5.879802129	1.45E-05	0.000359
SVIL	2.572592763	5.006413294	1.45E-05	0.000359
ARID4B	-1.226918458	7.714923959	1.45E-05	0.000359
PLCB3	5.079824454	1.877009098	1.45E-05	0.000359
TMBIM6	-1.761079169	10.46462478	1.47E-05	0.000362
CD3E	-1.643942506	8.389708965	1.48E-05	0.000364
DLSTP1	3.793946513	1.423122106	1.48E-05	0.000364
HCLS1	-1.513907029	8.893860264	1.50E-05	0.000367
RNF138P1	4.306165616	2.2926186	1.50E-05	0.000367
ORMDL1	-2.643057043	7.060309352	1.53E-05	0.000372
CENPF	4.494566576	3.636140559	1.53E-05	0.000373
SH3PXD2A	4.160558048	3.742642161	1.54E-05	0.000375
ELOVL6	6.065853704	0.714488285	1.56E-05	0.000379
MED14	2.168944559	5.585068121	1.57E-05	0.000381
KIF1C	2.986771845	4.603700719	1.60E-05	0.000387
NLGN2	4.943784429	1.25725167	1.62E-05	0.00039
RPLP2	0.968890137	8.029910603	1.64E-05	0.000395
DNAJB1	-1.799836433	7.73593329	1.65E-05	0.000395
GPR108	-1.902603437	6.707695448	1.66E-05	0.000397
MYO5B	5.508797732	1.092347361	1.68E-05	0.000401
MFGE8	3.212233902	3.789989091	1.68E-05	0.000402
RAB11FIP1	1.834101112	6.284860019	1.71E-05	0.000408
TSPAN4	5.578237277	1.864191236	1.73E-05	0.000411
RPA2	-2.387419125	7.2307647	1.74E-05	0.000411

FXYD5	-2.104930569	7.760872805	1.74E-05	0.000411
PPDPF	4.259371066	3.023217559	1.74E-05	0.000411
VPS28	-1.402423969	6.645192412	1.75E-05	0.000412
ILK	-1.48711453	7.678512717	1.76E-05	0.000412
POLR2A	2.421816077	6.563658777	1.76E-05	0.000412
COG4	-1.449298462	6.781981692	1.76E-05	0.000412
C1orf162	-2.515327298	6.238415044	1.76E-05	0.000412
MSI2	4.847305735	1.672641839	1.79E-05	0.000416
CD5	-3.38958023	7.338128989	1.81E-05	0.000422
SECISBP2L	1.702729925	5.425272979	1.82E-05	0.000422
PECAM1	2.92619708	6.814864252	1.82E-05	0.000422
CHMP4A	-1.932042773	6.314386213	1.82E-05	0.000422
CCNA2	2.827565536	3.695548309	1.83E-05	0.000422
ZNF282	3.182591464	3.647610412	1.83E-05	0.000422
MPHOSPH8	-1.622861887	7.156056492	1.84E-05	0.000422
PDLIM1	4.480700831	3.348087293	1.84E-05	0.000423
SEC14L1	1.833032361	6.286900935	1.84E-05	0.000423
DLEU2	2.479709705	3.642557066	1.86E-05	0.000425
NCAPG	5.786706566	1.515657669	1.88E-05	0.000429
SNX22	-1.038940042	7.891203342	1.90E-05	0.000433
SETD1A	4.054909116	2.825374931	1.93E-05	0.000439
CCDC152	6.043607606	4.314706357	1.96E-05	0.000445
DDOST	-1.164344145	8.07337733	1.97E-05	0.000445
YTHDC2	2.438088421	5.180292765	1.99E-05	0.000449
SNORD10	4.29089434	1.010541544	2.00E-05	0.000449
RXRA	4.694408519	3.716511075	2.00E-05	0.000449
SLC2A4RG	3.189407205	3.016875285	2.00E-05	0.000449
MCM4	2.835176754	4.578666629	2.01E-05	0.000449
MGRN1	4.121998496	3.872829531	2.01E-05	0.000449
RPS21	1.456008597	6.272187237	2.01E-05	0.000449
DOT1L	4.574270106	3.121491206	2.01E-05	0.000449
MAX	-1.331005824	7.010493903	2.03E-05	0.000452
UQCR11	-1.818767381	6.337409051	2.04E-05	0.000452
FMNL3	2.25690077	6.442611225	2.05E-05	0.000453
DLG5	6.138976812	3.038625375	2.05E-05	0.000453
OST4	-1.675251411	6.660685975	2.07E-05	0.000455
BRK1	-1.449004265	6.953406567	2.07E-05	0.000455
PLTP	2.413177302	6.439650462	2.07E-05	0.000455
YBX1	1.912038269	6.236317641	2.07E-05	0.000455
UBC	-1.409464036	11.30096453	2.07E-05	0.000455
ERP29	-1.823265245	7.418889575	2.08E-05	0.000455
SPOPL	3.136026884	3.924911114	2.08E-05	0.000455
NOTCH1	2.987159986	5.100897447	2.12E-05	0.000461
ARHGEF40	4.858280961	1.592538142	2.12E-05	0.000461
ATP6V1A	1.760068532	6.196842632	2.12E-05	0.000461
ASAP1	1.910131082	5.676706617	2.13E-05	0.000461
NCKAP1	5.343556982	2.664458337	2.14E-05	0.000463
HTT	1.878556411	6.690741093	2.14E-05	0.000463
SMG1P3	3.404947676	3.792198965	2.16E-05	0.000466
PAN3-AS1	5.249735047	0.676665521	2.18E-05	0.000469
NHP2L1	-1.473459924	7.090264884	2.21E-05	0.000474
RERE	1.751641679	5.514716818	2.24E-05	0.000481
GP1BA	5.230772401	0.501354664	2.26E-05	0.000484
LOC101243545	-1.432095215	6.942317763	2.31E-05	0.000494
SCARB1	5.736703884	1.703749629	2.34E-05	0.000498

NCOR2	4.599183385	4.499327548	2.34E-05	0.000498
CRLF3	-1.565718379	7.246844682	2.35E-05	0.000498
FBRS	3.694107757	3.847367289	2.38E-05	0.000505
MORF4L1	-1.191318327	7.285889859	2.39E-05	0.000505
TMEM131	1.719235005	5.959264509	2.39E-05	0.000505
KDM6B	4.606652212	3.46285593	2.39E-05	0.000505
APLP2	1.568118346	6.808525936	2.40E-05	0.000506
PIK3IP1	-2.731020434	8.454784826	2.41E-05	0.000507
RAB5C	1.599139404	5.55253803	2.44E-05	0.000512
TRAK1	2.082933576	5.469427532	2.45E-05	0.000512
CCDC88A	3.141098428	4.814595876	2.45E-05	0.000512
H6PD	1.86669379	6.7371954	2.47E-05	0.000516
OAZ1	-1.060249273	9.11221311	2.48E-05	0.000517
TRAF7	3.438920918	4.163526916	2.50E-05	0.00052
GPS2	-2.510041762	6.930059049	2.52E-05	0.000522
GAN	6.000826014	1.217156458	2.53E-05	0.000523
DRAM1	5.594067972	2.32263638	2.53E-05	0.000523
XRCC6	-1.067636704	8.545826017	2.53E-05	0.000523
CUTA	-1.73325879	6.654848325	2.54E-05	0.000523
PTPRK	5.204241195	2.430681245	2.55E-05	0.000524
TMEM173	-1.626321612	7.471737775	2.58E-05	0.000529
CD151	1.995212404	4.855286166	2.58E-05	0.000529
FYN	-2.191598519	9.329092564	2.59E-05	0.00053
RHBDD2	-2.03041255	6.727711393	2.60E-05	0.00053
MALAT1	1.623021644	13.36430443	2.60E-05	0.00053
CDK5RAP2	1.102408345	6.20602436	2.61E-05	0.00053
PITPNM2	5.771924316	1.580250635	2.61E-05	0.00053
PIK3R3	6.368097042	2.529041567	2.62E-05	0.000532
CYFIP2	-1.611732245	9.10896389	2.63E-05	0.000532
AASS	6.045710226	1.521790772	2.64E-05	0.000532
ATF5	3.855541128	2.942848121	2.64E-05	0.000532
C1orf21	6.869175243	3.487064719	2.66E-05	0.000535
RTN4	1.395661253	6.773739844	2.69E-05	0.00054
VPS37C	5.406797639	1.104180968	2.72E-05	0.000547
UBB	-0.982892436	9.168154274	2.74E-05	0.000549
MKI67	5.622927924	4.234576607	2.77E-05	0.000554
TET2	2.044474997	5.825476949	2.77E-05	0.000554
SUMO2	-1.228274855	6.987654223	2.79E-05	0.000555
LOC100128361	5.457003434	0.520127795	2.80E-05	0.000556
EVI2B	-3.198593581	7.224246528	2.80E-05	0.000556
MAPK3	3.702754336	3.219937185	2.86E-05	0.000568
CASKIN2	4.467492693	0.467161636	2.89E-05	0.000571
ENO2	-2.406891242	6.604572053	2.92E-05	0.000578
SHISA5	-1.462376518	8.097420725	2.93E-05	0.000578
ECT2	5.387292937	2.061199643	2.94E-05	0.00058
JARID2	1.750643147	5.9317207	3.07E-05	0.000604
HIST1H4C	1.954474991	5.231681102	3.08E-05	0.000605
SKP1P2	-2.845289142	2.473295599	3.11E-05	0.00061
LEPROTL1	-3.802646526	8.136857455	3.12E-05	0.00061
LMAN2	-1.239296399	7.711403379	3.18E-05	0.000619
RPN2	-1.32494742	8.70236297	3.18E-05	0.000619
BHLHE40	2.189236183	7.040407668	3.18E-05	0.000619
DUOX1	6.034814607	2.109382444	3.18E-05	0.000619
STXBP5	1.947618086	5.610312669	3.22E-05	0.000624
HDAC7	1.863935375	5.885549063	3.23E-05	0.000626

CORO1C	4.644831134	5.036730066	3.26E-05	0.000629
SNX18	5.147050843	2.970063944	3.26E-05	0.000629
RAPH1	4.314237852	2.259866933	3.26E-05	0.000629
PSMB1	-1.280049946	7.173297094	3.29E-05	0.000632
ATP5L	-1.429778413	6.999120323	3.29E-05	0.000632
LOC102723704	-2.377442272	5.642911444	3.29E-05	0.000632
AFF1	1.212951745	6.790821946	3.30E-05	0.000632
RPS19	-1.318322427	9.578836167	3.31E-05	0.000632
CD27	-2.739729974	6.781924564	3.33E-05	0.000634
ACVR1B	5.162491229	2.447390286	3.34E-05	0.000637
CD82	-1.605165792	7.535652762	3.40E-05	0.000645
EVI2A	-2.520708796	6.776203449	3.40E-05	0.000645
CLK1	-1.561176383	8.390736348	3.41E-05	0.000646
AKTIP	-2.580506567	6.958824527	3.45E-05	0.000653
ENSA	1.229194623	6.042650183	3.50E-05	0.00066
MED13	2.184982215	6.768227594	3.53E-05	0.000666
GOLGA7	-1.988355666	6.807948794	3.54E-05	0.000667
PAPSS2	5.584734173	1.268799598	3.58E-05	0.000673
COX7A2L	-2.080145225	6.604208126	3.62E-05	0.000679
SCML4	-2.386704274	7.312600745	3.65E-05	0.000684
RLIM	1.821914664	6.121489917	3.67E-05	0.000686
CEBPA	5.191436314	1.851185089	3.67E-05	0.000686
SYMPK	2.122385235	5.524111188	3.69E-05	0.000688
KIF20A	3.247699238	2.376298872	3.69E-05	0.000688
SH3BP1	3.703598459	4.499325367	3.75E-05	0.000697
ARHGDIA	2.221939128	6.36124827	3.79E-05	0.000703
CD8B	-5.258416987	7.451323196	3.80E-05	0.000704
SEPT8	2.167619805	4.923613074	3.84E-05	0.00071
BCL9L	2.336959974	5.624003364	3.86E-05	0.000713
ARHGAP10	3.144474904	3.804098772	3.89E-05	0.000718
CTSC	1.413968266	7.923739939	3.92E-05	0.000721
SSB	-1.519238771	6.75873219	3.92E-05	0.000721
TMEM230	-1.46953902	6.871500536	3.93E-05	0.000721
ALG13	1.89827935	5.213563979	3.95E-05	0.000724
KIF13B	2.547031162	5.06525791	3.96E-05	0.000724
PLOD1	5.202568603	3.534922567	3.97E-05	0.000725
TMBIM4	-1.694133348	6.901545511	4.02E-05	0.000733
DNTTIP2	-1.923452248	7.317452747	4.02E-05	0.000733
SPTBN1	2.83410013	7.128344695	4.07E-05	0.000739
PATL1	1.905146012	5.107541409	4.07E-05	0.00074
LITAF	-1.341060215	8.643867887	4.09E-05	0.000741
ATP1A1	2.051897232	7.558607268	4.25E-05	0.000768
ALOX5AP	-4.328071508	7.985321352	4.25E-05	0.000768
FLNB	3.11266146	5.809450834	4.26E-05	0.000769
XIAP	1.81613606	5.922687937	4.28E-05	0.00077
DPY19L3	3.708330211	3.622357945	4.29E-05	0.00077
PDCD4	-2.589330779	9.269554996	4.29E-05	0.00077
ACOX1	1.818630263	5.827110582	4.30E-05	0.00077
RHOA	-1.112864927	9.46999993	4.41E-05	0.000789
CTBP2	5.66882187	1.456399148	4.42E-05	0.000791
WNK1	1.444988631	8.144378372	4.44E-05	0.000793
CCDC53	-2.022988263	5.588323814	4.45E-05	0.000793
FOXK1	1.813121007	6.356303632	4.46E-05	0.000793
EPN1	5.50880856	2.764587387	4.47E-05	0.000794
SBF2	2.740922159	4.743550249	4.51E-05	0.0008

ISG20	-3.184602876	7.507440099	4.52E-05	0.0008
SH3BP2	1.762653612	6.786183192	4.56E-05	0.000806
CELSR2	6.485370993	1.242923292	4.57E-05	0.000807
RHOH	-1.756209442	7.285681276	4.59E-05	0.000808
B4GALT2	5.418857962	1.331031407	4.60E-05	0.000808
ARHGAP31	4.970264664	3.691443149	4.60E-05	0.000808
ZFAND3	4.112716054	2.785669928	4.60E-05	0.000808
HIVEP1	2.557662425	5.103372072	4.65E-05	0.000814
SNRPD2	-1.337863112	6.838117553	4.71E-05	0.000825
KDELR1	1.394406817	5.12500322	4.74E-05	0.000828
TMBIM1	-1.22226605	7.859872421	4.79E-05	0.000836
PEX26	4.196365251	3.457079627	4.82E-05	0.00084
RNF44	2.11154514	5.012085408	4.83E-05	0.00084
SP1	1.316654328	6.795874164	4.84E-05	0.00084
PSME2	-1.322479623	7.03449657	4.84E-05	0.00084
SLC25A38	-2.137277681	6.618864804	4.85E-05	0.00084
LINC01550	-4.030660521	2.666169522	4.92E-05	0.000851
DOCK7	5.710504939	2.458366455	4.93E-05	0.000851
REEP5	-1.402943233	7.906724442	4.94E-05	0.000851
RNF19B	4.498716895	3.217436926	4.95E-05	0.000851
SS18L2	-2.747691424	5.378074972	4.95E-05	0.000851
GOLGA2	1.829960592	4.913851014	5.05E-05	0.000867
SSR4	-1.233931684	7.008946091	5.09E-05	0.000873
FGD3	-1.929033073	7.945762351	5.12E-05	0.000877
GALNT2	2.421247401	4.834369307	5.14E-05	0.000879
NOP56	-1.092793787	7.377261108	5.21E-05	0.000889
NBPF10	2.200953478	3.684599236	5.22E-05	0.00089
MEI1	-3.059927218	6.301202629	5.25E-05	0.000894
NPC2	1.816816116	4.662958966	5.26E-05	0.000894
WDR62	5.188099551	0.653748957	5.28E-05	0.000896
PCMT1	-1.691125814	6.985075227	5.30E-05	0.000897
RAD54L	4.057937352	2.182744724	5.34E-05	0.000904
SLFNL1-AS1	2.762683597	2.846593369	5.37E-05	0.000908
RNF169	2.006334693	5.77696693	5.43E-05	0.000915
LDHB	-2.346492157	8.812872862	5.45E-05	0.000917
ALMS1	2.622603454	5.138302207	5.49E-05	0.000922
SH2B3	2.089618555	6.470457289	5.50E-05	0.000923
ABTB2	4.796112732	0.377145484	5.54E-05	0.000928
ZNF710	4.927295539	2.661818679	5.58E-05	0.000935
NAV1	5.060982701	2.494146977	5.62E-05	0.00094
DOC2A	3.185050403	0.859011701	5.69E-05	0.000949
CENPE	5.967087414	1.590655046	5.73E-05	0.000955
KPNA4	1.769090953	6.055200877	5.74E-05	0.000956
ACP1	-1.742041328	6.926056791	5.80E-05	0.000964
REXO1	5.149803892	1.990239041	5.84E-05	0.00097
GRN	1.749316922	7.341166097	5.87E-05	0.000973
CLIP2	5.407951536	2.161961122	5.96E-05	0.000985
SLC30A4	5.104635668	1.553114209	5.96E-05	0.000985
ZDHHC20	1.809376557	6.29598193	6.00E-05	0.000989
RPS25	-0.938904453	8.036763313	6.00E-05	0.000989
PTAFR	5.696749837	1.653660291	6.04E-05	0.000993
MAP4	1.137349126	7.78758921	6.04E-05	0.000993
ZNF619	6.065918868	1.148865062	6.18E-05	0.001015
MTA1	5.134133174	2.545233395	6.34E-05	0.001037
SRRM1	-1.134438035	7.588067643	6.35E-05	0.001037

EEF2K	2.416078434	4.97669562	6.36E-05	0.001037
PDDC1	2.079954933	5.023693589	6.36E-05	0.001037
OTUD6B-AS1	-2.033697118	5.321070618	6.44E-05	0.00105
KANSL1	1.292596123	6.781263738	6.46E-05	0.001051
LINC00892	-3.745895098	3.036102566	6.60E-05	0.001072
CD81-AS1	4.911457164	1.210003568	6.61E-05	0.001072
UBE2L6	-1.406241171	7.520844263	6.71E-05	0.001087
ENG	2.959646002	4.413078461	6.75E-05	0.001092
PCNP	-1.539688068	7.294523964	6.92E-05	0.001118
NOP58	-1.789348635	7.453628438	6.94E-05	0.001121
EPB41L2	4.834904505	3.778950218	6.96E-05	0.001121
DCAF11	-1.063830661	7.219508637	6.97E-05	0.001122
CDC42BPB	4.931491581	2.25816804	6.98E-05	0.001122
HBP1	-1.811165776	7.837399618	7.01E-05	0.001124
NAF1	3.946995699	1.3888056	7.06E-05	0.001131
SIT1	-2.375865649	6.499656791	7.08E-05	0.001133
PPP1R2	-1.996831831	7.337158485	7.09E-05	0.001133
DNAH1	3.307039523	5.04402704	7.11E-05	0.001134
TPX2	6.168996024	2.549617893	7.12E-05	0.001134
HNRNPUL2	2.766904933	3.221246135	7.13E-05	0.001134
SCD	6.430393487	1.937068611	7.13E-05	0.001134
MEF2D	2.355828205	5.483906468	7.18E-05	0.001137
PRKCSH	1.98256579	5.684855943	7.18E-05	0.001137
ZNF664	2.717128816	4.834936678	7.18E-05	0.001137
SZRD1	1.73619596	5.948684065	7.22E-05	0.001141
ATP5EP2	-2.760581083	2.164926553	7.40E-05	0.001168
NDRG1	3.280612416	5.474388216	7.42E-05	0.00117
NEK6	3.264910996	4.14654096	7.51E-05	0.001183
ABL2	3.814617818	4.62187942	7.56E-05	0.001189
ABHD2	1.632562215	6.652493962	7.59E-05	0.001192
NOP2	-1.256780906	6.886756716	7.62E-05	0.001194
QSER1	3.743454099	3.427079387	7.67E-05	0.001201
SGK223	4.842349499	1.767529485	7.73E-05	0.001208
MEGF8	4.015322608	3.021670414	7.75E-05	0.00121
ZNF217	1.157711206	6.733874094	7.77E-05	0.001212
LMNB1	5.334278714	4.051017214	7.84E-05	0.001222
ANKRD36BP1	3.988924188	3.924108916	7.89E-05	0.001228
METRNL	4.842534415	2.507554097	7.94E-05	0.001233
PLXND1	5.555117733	4.94246398	7.99E-05	0.00124
CYLD	-1.150960564	8.775668649	8.03E-05	0.001245
PELP1	1.974790989	4.274803625	8.10E-05	0.001253
SIPA1L3	3.574950881	3.417186334	8.16E-05	0.00126
PEBP1	-1.071122453	7.765705663	8.16E-05	0.00126
RHOQ	1.561821257	5.302597936	8.29E-05	0.001278
RARRES3	-2.826551939	6.247234702	8.31E-05	0.001279
SUMO1	-1.652352991	6.586006132	8.33E-05	0.00128
MED10	-2.239890061	5.911438144	8.40E-05	0.001289
GSTCD	5.210072778	1.059459403	8.44E-05	0.001293
WHSC1	2.133376196	6.24393076	8.54E-05	0.001307
HIVEP3	6.333930171	3.031795371	8.64E-05	0.001321
WSB2	1.50770413	5.625647377	8.66E-05	0.001322
PPP2R5C	-1.254684745	8.067844243	8.70E-05	0.001326
UBALD2	4.493437788	2.151889141	8.72E-05	0.001328
AIF1	5.111580459	1.545926523	8.78E-05	0.001336
KLF9	3.147221138	4.29601881	8.85E-05	0.001345

TSTD1	-2.233496813	5.822359003	8.88E-05	0.001347
MAP4K4	1.271449395	6.944804151	8.94E-05	0.001354
TOR4A	5.005414483	1.633063298	8.99E-05	0.00136
ATP6V0C	3.583902721	3.585939134	9.08E-05	0.00137
TEAD2	3.984750881	0.405559816	9.08E-05	0.00137
VASH1	1.950683001	5.20512714	9.12E-05	0.001373
ELL2	2.720258597	4.838946828	9.12E-05	0.001373
PRR11	4.594045837	2.338376482	9.22E-05	0.001386
PTPN12	4.700417308	4.123985588	9.23E-05	0.001386
GLTSCR1	4.430141106	1.847313419	9.45E-05	0.001417
EIF4G3	1.947927098	5.763063049	9.58E-05	0.001434
E2F3	3.921184738	4.297090633	9.62E-05	0.001436
BMP2K	4.667001121	3.003927003	9.62E-05	0.001436
RSRP1	-1.559779717	7.358071778	9.64E-05	0.001436
SLA	-2.356679374	8.436238791	9.65E-05	0.001436
PSMA2	-1.448800173	6.67617563	9.65E-05	0.001436
FMNL1	1.953465033	6.771606112	9.70E-05	0.001442
HAX1	-1.838974699	6.685919956	9.73E-05	0.001443
CDC42SE2	-2.071858373	9.145195341	9.75E-05	0.001445
TMEM179B	-2.128091398	6.16086445	9.88E-05	0.001463
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AP2A2	4.363954775	3.94795027	0.000100752	0.001487
UBE2E1	2.315925724	3.863671382	0.000101036	0.001489
CLK3	-1.410875786	6.65700007	0.000101106	0.001489
KDELR3	2.620654646	1.832632708	0.000101259	0.001489
PEA15	2.655572266	4.341509234	0.00010156	0.001491
PPIB	-0.95588654	8.127341047	0.000101657	0.001491
PCBP2	1.486329294	7.530185081	0.000101756	0.001491
RPL28	1.38091104	7.562826129	0.000102375	0.001498
XYLT1	2.549110987	4.710263224	0.000102536	0.001499
PRDX2	-2.209453791	7.017591589	0.000103459	0.00151
POLR3GL	-2.36019782	6.126852085	0.00010355	0.00151
PSMB3	-1.327973346	6.881591853	0.000103825	0.001512
SERTAD2	2.999362658	4.591796136	0.00010404	0.001513
UTRN	1.505360191	8.299486493	0.000104441	0.001517
HNRNPUL1	1.621584628	6.963709403	0.000105569	0.001531
ABCD1	5.2229583	1.475210717	0.000105713	0.001532
TTC1	-1.862658609	6.199701824	0.000106152	0.001536
ARFGAP2	-1.023788881	7.44633283	0.00010667	0.001541
STARD9	3.079573986	4.970191307	0.000106759	0.001541
AK6	-2.303461028	4.234973016	0.000107332	0.001547
SCRIB	5.285695876	2.852455744	0.000107467	0.001547
CRB2	4.756604712	1.31583688	0.000107833	0.001551
SEC11C	-2.3571844	5.673435038	0.000108444	0.001557
C4orf3	-1.173927651	7.117341853	0.000108779	0.00156
MRPS18B	-1.856508709	6.558511986	0.00010922	0.001565
CLTC	1.368782153	8.368611357	0.000111024	0.001589
S1PR1	-3.064915254	7.390513262	0.000111231	0.00159
SLC40A1	3.13979075	5.216833446	0.00011164	0.001594
KCTD9	2.08254451	4.204334356	0.000111896	0.001595
LAPTM5	-1.155925755	9.599369667	0.00011207	0.001596
SRSF11	-0.882818593	7.850343487	0.000112291	0.001597
XPC	-1.459729366	7.494389043	0.00011295	0.001604
UQCR10	-1.828793342	5.667425483	0.00011364	0.001611
GPC1	5.327038001	1.204729047	0.000113681	0.001611

TEP1	2.435479679	5.705173812	0.000114252	0.001615
CTNNB1	1.58282516	7.446036325	0.000114258	0.001615
APOBEC3C	-1.888180432	7.512093834	0.000115443	0.00163
TMEM86A	4.275687976	2.092107216	0.000117504	0.001657
ATP11A	2.959104906	4.893455447	0.000117644	0.001657
LGALS9	2.709060203	3.360535503	0.000118828	0.00167
CHST14	4.831001875	1.09919585	0.000118844	0.00167
TPM3	-0.811336313	9.234565397	0.00011902	0.00167
FBRSL1	3.804289119	2.736873732	0.00011975	0.001678
TRMT112	-1.387856474	6.42173324	0.000120762	0.00169
GSK3B	2.188006346	5.183613886	0.000120868	0.00169
ATP8B5P	-3.279187521	0.367069148	0.00012138	0.001695
PLCB1	6.393629148	1.407592474	0.000122157	0.001702
COL6A2	6.953997112	4.872827759	0.000122184	0.001702
CHSY1	2.5785364	5.273167237	0.000122356	0.001703
GIMAP1	-2.463414912	6.828431114	0.000123014	0.00171
UBE2L3	-1.865767906	7.052882134	0.000124335	0.001724
PDHB	-1.343461112	6.584561958	0.000124338	0.001724
PSMB6	-1.764889142	6.769309812	0.000124694	0.001727
ZNF358	4.642574945	1.175288069	0.000125288	0.001732
FCGRT	3.543785229	5.082881321	0.000125336	0.001732
ZNF512B	5.362659579	2.131445008	0.000125856	0.001736
FUS	1.906157859	6.652985926	0.000125938	0.001736
BMP1	5.194206058	2.151232278	0.000126611	0.001743
MAFK	3.757343805	2.603150901	0.000127747	0.001757
LOC101927817	4.956390272	0.379264059	0.000128035	0.001758
GIMAP6	-1.816596888	8.533388198	0.000130594	0.001791
ANAPC1P1	-4.160377354	3.293986355	0.000131953	0.001808
USP32	1.816571387	5.253210091	0.000133056	0.001819
LOC101927051	4.338588749	3.50212422	0.00013306	0.001819
CFH	6.59710539	4.184856822	0.000133355	0.001821
GALT	-2.209540931	6.772654566	0.000133653	0.001823
TAB1	2.086728949	4.026699296	0.000133911	0.001823
SEPN1	2.546726483	4.025117927	0.000134024	0.001823
RASSF3	2.142403384	4.529013772	0.000134737	0.001829
MAST2	4.716077757	2.864721764	0.00013474	0.001829
MICAL3	3.196955333	4.484452212	0.000135333	0.001835
SOCS7	2.688379465	4.143542638	0.000135862	0.00184
ATP8B1	2.760467897	3.452007537	0.000136305	0.001844
UBR4	1.317626323	8.268325867	0.00013652	0.001844
KIAA1109	1.302308069	7.538900933	0.000136695	0.001845
C11orf95	4.749677119	1.037767746	0.000138493	0.001867
FAM208B	2.311341081	5.785711173	0.000138783	0.001868
MYL6	-1.13589254	8.884773112	0.000139031	0.00187
SRI	-1.433418655	6.774162967	0.000139369	0.001871
ETV3	3.426486817	3.133401095	0.000139458	0.001871
DARS	-1.498744485	7.372605642	0.000139652	0.001872
ZNF185	5.908690258	1.150095574	0.000140476	0.00188
RGS5	4.247070435	2.118880112	0.000140768	0.001882
MGAT5	1.279928928	5.884670007	0.000141367	0.001888
HTRA1	5.139756403	1.878027324	0.000141694	0.00189
ATP2C1	2.448585751	5.6579637	0.000142479	0.001898
ARPC3	-1.081515454	7.457676163	0.000143179	0.001906
ABALON	2.17928878	4.374904803	0.000143448	0.001907
SIRPG	-2.582167792	6.312436362	0.000144107	0.001914

APOL1	2.721254604	5.435554028	0.000144375	0.001915
PPIF	2.329859399	4.97275452	0.000144695	0.001917
ACACA	3.364172286	4.692398388	0.000144986	0.001919
CLEC2D	-2.210190407	8.690273773	0.000146349	0.001933
C1orf74	-1.878010739	7.184694135	0.0001464	0.001933
FNDC3B	4.676820174	3.591885584	0.000146727	0.001935
RBBP8	5.182603734	1.939065465	0.00014761	0.001944
CD68	3.838337217	4.367650262	0.000147769	0.001944
TMPRSS9	4.779306623	0.10726067	0.000148202	0.001948
KIF2C	4.959948026	2.057899544	0.00014845	0.001949
ARHGAP35	1.670662343	6.194495945	0.00014879	0.001951
LY9	-3.867175974	7.671012166	0.000149693	0.001961
AP2S1	1.658594651	4.323053956	0.000149844	0.001961
DPY30	-2.195864861	5.15271596	0.000150011	0.001961
LOC146880	1.913419653	4.920448677	0.000151587	0.001979
DHFR	3.618372334	1.98295999	0.000152452	0.001988
CLSTN3	2.238781281	5.858072021	0.000153337	0.001997
AXL	6.204328508	2.584286277	0.000154053	0.002004
RNF144B	5.185726813	2.24061425	0.000155788	0.002025
KRR1	-1.798687123	7.386241615	0.000156709	0.002034
GMPR2	-1.647238781	6.765991864	0.000157181	0.002038
GEN1	4.578215081	2.38930318	0.000158936	0.002059
SMG1P1	3.024073453	3.192496063	0.000159994	0.00207
LOXL2	5.150173204	2.480964538	0.000161614	0.002089
SLX4	4.270291504	2.359960692	0.000161827	0.002089
ILF2	-1.318991492	7.69392348	0.000162013	0.002089
NLRP1	-1.407014925	8.20416695	0.000162453	0.00209
MTMR10	1.63017656	5.51086759	0.000162472	0.00209
NXF1	-1.15270619	7.927761105	0.000162789	0.00209
HELLS	3.776605111	3.120768076	0.000162804	0.00209
TUBA1B	1.282654308	8.239694069	0.000164247	0.002106
FOXP4	4.958494044	1.787040772	0.000164726	0.00211
SFMBT2	2.514232263	6.138210529	0.000165132	0.002113
BCL2L1	1.864602632	5.538619575	0.000166306	0.002125
GABARAP	-1.174489162	7.658577183	0.00016645	0.002125
TUBA1C	1.357339349	5.937826277	0.000166916	0.002129
PRMT2	-1.531797223	8.31608095	0.000168157	0.002142
MAPKAPK5-AS1	-1.870831803	5.886388108	0.000169673	0.002158
ZDHHC21	2.265227244	3.784563528	0.000169767	0.002158
HIPK3	1.661094749	7.161073181	0.000170101	0.00216
ALDOA	-1.257369212	10.04037766	0.000170291	0.00216
ZNF81	5.621758078	1.85621291	0.000170479	0.00216
UXS1	-1.592502857	6.276560483	0.000172388	0.00218
IDH3B	-1.507491072	6.849464815	0.000172418	0.00218
SNTB2	1.275436613	6.056761638	0.000172835	0.002181
MRPS5	-2.055399655	6.100508307	0.000172871	0.002181
SIRT6	4.503802049	1.048974536	0.000174681	0.002201
OSBPL3	2.34879557	6.01932703	0.000174842	0.002201
ALPK1	4.662759548	1.820187537	0.000175603	0.002208
KPNB1	1.19645198	7.507406992	0.000179469	0.002252
KDM7A	2.175180353	5.920604608	0.000179491	0.002252
SETD7	3.80431965	4.260724512	0.00018035	0.002261
AP2A1	4.089096282	3.715765813	0.000181275	0.00227
SLC5A3	2.822650379	4.93141668	0.000182183	0.002279
PPIG	-1.470622231	6.654761556	0.000182547	0.002279

VRK3	-1.798602058	6.263476733	0.000182608	0.002279
FAM109A	5.246747756	1.084316875	0.000183489	0.002287
TRIM22	-1.517562088	8.459189988	0.000183707	0.002287
CFLAR	0.819604359	8.554516606	0.000183853	0.002287
IFI30	2.141431289	5.301037703	0.000184083	0.002288
HIST4H4	3.745288925	1.606981949	0.000184344	0.002288
CENPO	1.476527294	5.048450258	0.000185412	0.002299
AP2M1	-0.939605402	8.210952736	0.000185689	0.0023
TOMM5	-1.627608381	5.687549394	0.00018627	0.002305
SP100	-1.181053681	8.532139041	0.000188161	0.002324
HERC2	1.815652133	6.231680077	0.00018819	0.002324
CCT7	-1.126812331	7.917725756	0.000190252	0.002347
ACTA2-AS1	3.144460149	3.795618807	0.000191581	0.002361
EEF1D	-1.413663829	9.119464103	0.000193297	0.002379
FBXL18	4.134308724	2.990569317	0.000193727	0.002382
DENND2D	-1.145175474	8.207744423	0.000194242	0.002386
TAF1	1.84600238	5.893769092	0.000194947	0.002392
DDX39A	-1.06189764	7.172051636	0.000195577	0.002397
TFIP11	-1.410274987	6.890461887	0.000196706	0.002408
ENTPD1	1.540985405	6.004459749	0.000196872	0.002408
HERPUD1	-1.713209117	8.038527544	0.000197383	0.002411
UGCG	2.646814183	5.210553747	0.0001976	0.002411
PCED1B	-2.549979207	6.472597126	0.000198099	0.002411
MMP19	3.830961391	3.577472399	0.000198154	0.002411
MYO9B	2.382653532	6.778590426	0.000198159	0.002411
CD14	5.614865726	2.4746098	0.000198713	0.002415
CDK1	5.65906485	1.311668496	0.000199052	0.002417
NRBP1	-1.191192363	7.351326785	0.00019971	0.00242
BLK	5.910268252	1.410243343	0.000199777	0.00242
GMFG	-1.946395301	6.967352618	0.000202581	0.002451
CPEB2	3.95870579	3.022166315	0.000202756	0.002451
NHLRC2	4.185793121	3.390575778	0.000203211	0.002454
VDAC3	-1.570969699	6.984412162	0.000205683	0.002482
VPS9D1-AS1	4.754007057	0.558677697	0.000206086	0.002484
IFNG-AS1	4.82988093	0.866432251	0.000208341	0.002509
KCNQ1OT1	2.706017632	4.849938018	0.000208877	0.002512
CANT1	1.917125386	4.456126265	0.000211146	0.002537
GGPS1	-2.093594616	5.721214545	0.000212544	0.002551
MIB1	2.70708641	5.738290407	0.000214523	0.002572
IFFO2	4.56714595	3.340894338	0.000215074	0.002576
TAPT1-AS1	2.50952694	2.451157979	0.00021604	0.002585
ZSWIM4	4.033940121	2.022500969	0.000217041	0.002594
CDC42BPG	5.695976464	0.768555516	0.000219823	0.002625
MPRIP	1.393487137	6.675440147	0.000221039	0.002636
PSMB10	-1.109473333	7.507714774	0.000221184	0.002636
SREBF1	5.509693184	3.350899088	0.000221674	0.002639
DNMBP	5.484995954	2.3023229	0.000222825	0.00265
TRIM66	3.575692596	3.770854283	0.000223122	0.002651
EXT1	4.564027069	3.067287629	0.000223919	0.002656
FLAD1	-1.821124864	6.542940012	0.000224213	0.002656
NRIP1	6.114662844	3.48554702	0.000224284	0.002656
ZC3H15	-1.314251193	6.417403732	0.00022481	0.00266
ZBTB7B	4.742761786	2.671623577	0.000225393	0.002664
PURB	3.333666814	4.655024747	0.000225731	0.002665
SEPT7	-1.210455583	8.552163201	0.00022634	0.00267

LEF1	-2.108285459	7.209965985	0.000228216	0.002689
PLK1	4.56540256	1.118953993	0.000231399	0.002724
BACE1	1.958181689	4.196519938	0.000232189	0.002731
ACSL4	1.901005511	5.893315937	0.000232452	0.002731
TRPM2	4.876103919	1.463572554	0.000233096	0.002733
C5orf42	4.422045298	3.942088558	0.000233204	0.002733
GBF1	1.575940578	6.421286239	0.000233339	0.002733
ZNF629	5.516867309	1.413574073	0.000234485	0.002742
TIMM22	-1.924524313	5.460493718	0.00023468	0.002742
WIZ	4.702476474	2.17074785	0.000234803	0.002742
CD28	-3.191360286	6.677782063	0.00023566	0.002749
SNX12	3.680440243	2.925291742	0.00023647	0.002756
KNTC1	2.13496378	5.450159979	0.000237605	0.002763
IBA57	3.670128262	3.578451459	0.00023803	0.002763
BTN3A2	-2.28282267	8.438719015	0.000238047	0.002763
JUND	2.554386688	5.806525999	0.000238132	0.002763
DENND1A	2.466251934	4.11996248	0.000238263	0.002763
ODF3B	4.587222094	1.188704681	0.000238973	0.002768
RASA4	3.181007369	1.296763185	0.000240103	0.002774
NCF2	5.227950127	1.747750825	0.000240331	0.002774
PPP2CB	2.563108691	3.597234022	0.000240373	0.002774
VAV2	5.548616485	1.694293782	0.000240444	0.002774
ATF6B	1.248925181	6.120079189	0.000241002	0.002778
SCART1	6.605126285	2.256621685	0.000241482	0.002781
HDAC1	-1.345569928	7.757202934	0.000242031	0.002784
CBL	1.383408157	6.777014946	0.000242822	0.002791
PCNX	1.25584369	7.495831442	0.000244005	0.002801
HSPB1	3.482718738	3.823655045	0.000244608	0.002805
IRF9	-1.268265409	7.352012356	0.000244833	0.002805
UBA7	-1.666806104	7.681281508	0.000246608	0.002823
CLUH	5.461776879	3.166824747	0.000247885	0.002834
LINC01420	-2.105174711	4.920106309	0.000248082	0.002834
AGBL5	-1.423735177	6.559685333	0.000250717	0.002862
NDUFV2	-1.866529849	6.513449896	0.000251369	0.002866
VIM	2.06467046	9.565695347	0.000253212	0.002884
C2orf74	-2.345317236	4.11480506	0.000254482	0.002896
MFSD7	4.662805422	0.390168483	0.000255492	0.002905
PRR14L	1.676132243	6.42475441	0.000258392	0.002935
HNRNPAB	1.929530241	5.955237652	0.000258771	0.002936
RABAC1	-2.318822627	6.195570783	0.000259146	0.002938
POU2F1	1.766536715	5.613973999	0.000259541	0.002939
IST1	-1.230715261	7.979731011	0.000260205	0.002942
COLGALT1	1.331654754	6.752865284	0.000260259	0.002942
GLOD4	-1.67467404	6.568763482	0.000262172	0.00296
LYZ	6.6548031	3.498343676	0.00026375	0.002975
TJP2	4.42615489	1.649192841	0.000264287	0.002978
PIKFYVE	1.623319265	6.101650024	0.000265414	0.002988
WAS	3.123608484	3.6366705	0.000266184	0.002994
MLLT1	3.48744918	3.168272153	0.00026682	0.002998
EIF5AL1	3.832519611	2.901454109	0.0002675	0.003003
WASL	3.446730688	3.170999392	0.000269083	0.003018
CD200R1	-3.600829998	5.241055292	0.000270527	0.003031
PSME4	1.634238024	6.2619269	0.000271154	0.003034
UBA3	-1.805011211	6.961034837	0.000271306	0.003034
KBTBD3	-2.355168058	4.057507845	0.000271651	0.003035

RAB34	5.180618817	0.797813731	0.000272797	0.003042
CTSD	3.00588772	7.216993693	0.000272851	0.003042
BRWD3	2.204478826	5.111017531	0.000273768	0.00305
PPP1R12C	5.180813039	3.196628822	0.000276643	0.003078
ZAK	5.248326334	2.606014505	0.000276855	0.003078
CFAP36	-2.259633676	4.873446266	0.000279718	0.003107
RNF213	1.357531031	10.18686997	0.00028026	0.00311
ATXN7L3	2.096744729	4.995536929	0.00028106	0.003116
PANK3	3.656950297	3.650798665	0.000282086	0.003124
TSPAN15	5.970718836	1.208719156	0.000282641	0.003128
CUTC	-2.154761661	5.712583568	0.00028298	0.003128
COL4A3BP	1.559595514	5.168860545	0.00028383	0.003135
PSD4	2.605730156	6.454636772	0.000285135	0.003146
CRBN	-2.48442104	7.27608669	0.000287748	0.003172
RAB35	3.020138853	4.292520157	0.000288693	0.003179
RCN1	4.719240738	2.676374717	0.000289203	0.003182
ATP5O	-1.0599848	6.681109986	0.00029019	0.00319
TYMS	2.590211664	4.091990331	0.000291927	0.003204
CHAMP1	4.043898549	2.841045774	0.000292052	0.003204
ARHGAP26	1.490364249	6.206450011	0.000293295	0.003215
RPL15	-1.490216743	9.798134869	0.000294847	0.003229
MKNK2	2.113332681	5.672533094	0.000297057	0.00325
HLA-DQB1	2.632752712	5.676631359	0.000299168	0.00327
SLC12A9	3.552925533	3.732353863	0.000299946	0.003275
PTPN23	3.097047322	3.450753513	0.000301645	0.003291
PPM1A	1.57299137	5.583162129	0.000304372	0.003318
METTL7A	4.217861206	3.226658837	0.000306305	0.003335
FAM32A	-1.748876414	6.769182611	0.000309241	0.003364
METTL17	-1.612883021	6.84983284	0.00030949	0.003364
FAM162A	-1.920121345	5.528057247	0.000309934	0.003366
PKD1	3.645989552	4.932775298	0.000311197	0.003376
ANXA7	-1.45122523	8.089926693	0.000312332	0.003385
TOP1	1.34604159	5.72846143	0.000313129	0.003388
MAZ	1.993977484	5.945944482	0.000313152	0.003388
MED11	-1.968503262	4.652773603	0.000313922	0.003392
NDUFA12	-2.350374324	5.360257924	0.000314144	0.003392
ILF3-AS1	-2.111398932	5.192303655	0.000316226	0.003412
PASK	-2.698077645	6.904284019	0.00031717	0.003419
DAG1	3.281486246	3.227344183	0.000317533	0.003419
GLIPR2	-1.293371581	7.187838337	0.000320837	0.003452
RNF113A	-2.811218444	5.811194147	0.000321358	0.003454
PTPRC	-1.597748323	10.98209875	0.000323514	0.003474
RCOR1	3.43528891	3.875472296	0.000324158	0.003478
HK2	3.274414797	3.342987167	0.000325143	0.003485
PSMA6	-1.236877663	6.811122202	0.000325395	0.003485
CAMK2D	1.856604292	5.627546492	0.000325763	0.003485
NOCT	3.915186965	2.671498892	0.00032691	0.003493
DPF2	-1.713230121	6.936821732	0.00032706	0.003493
PLEC	4.030129641	7.494972792	0.00032816	0.003501
VPS53	1.135634991	6.055283428	0.000331621	0.003535
EFEMP2	4.8156722	1.250180659	0.000333462	0.00355
ATP5F1	-1.316676916	7.469353679	0.000333643	0.00355
HCP5	-1.542682813	7.450336399	0.00033588	0.003569
CCL5	-2.495462153	8.44768173	0.000336081	0.003569
TMEM187	-2.318642013	4.054666676	0.000337023	0.003576

PARD6G	5.302909464	0.535168389	0.000338342	0.003587
SELK	-2.567814692	5.687134576	0.000338964	0.00359
PRRC2B	1.064316837	8.330635123	0.00034113	0.00361
FAM219A	4.448082039	1.75139528	0.000341463	0.00361
REL	1.640599182	6.120654437	0.000342169	0.003614
ZBTB46	2.714817584	2.489450762	0.000343556	0.003626
SOX12	4.240575532	1.086360038	0.000345305	0.003638
CSF1	6.350704135	3.542000886	0.000345603	0.003638
ZDHHC14	4.751835704	1.833967484	0.000345662	0.003638
TC2N	-1.797833837	8.632884378	0.000346519	0.003644
QSOX1	2.7289048	4.162018898	0.000346925	0.003645
WDR90	4.670082074	2.338403187	0.000348605	0.003659
CD27-AS1	-2.312752435	6.259616039	0.000349276	0.003663
FAM46A	5.215991717	2.148127336	0.000354669	0.003716
XPO1	1.366713451	7.263011605	0.000355787	0.003724
HNRNPK	-1.132433385	9.560905599	0.000358345	0.003744
MARS	-0.911099626	7.476942611	0.000358404	0.003744
SLC36A1	3.741662276	3.142997406	0.00035861	0.003744
PLCH2	4.736262748	2.882848078	0.00036076	0.003763
EXPH5	4.927715461	1.778823958	0.000361808	0.003768
DIP2B	3.150708451	4.910896653	0.000361952	0.003768
IL12RB2	5.359696665	1.698003003	0.000362332	0.003769
CYP4F22	4.976225306	2.127476637	0.000368659	0.003831
CUX1	1.767390974	5.86064545	0.000369276	0.003834
ZNF516	3.95469545	2.569761942	0.000369619	0.003834
PPP1R7	-1.900377164	6.512860315	0.0003714	0.00385
ATP13A3	3.653958798	5.393469645	0.000373061	0.003863
TBC1D32	3.319939172	2.994299775	0.000373954	0.003869
DAD1	-1.638090967	6.494225567	0.000374711	0.003873
PPP3CB	2.067964318	4.926348553	0.000375749	0.003881
AGAP3	3.023922103	4.310040607	0.000376154	0.003881
JAK2	2.538519413	5.04694991	0.000376454	0.003881
CAMK4	-3.448707689	6.482655976	0.000377969	0.003893
TRAM2	2.619362696	4.485061498	0.000378928	0.003896
CHCHD10	3.780930163	0.723741254	0.000378945	0.003896
MARK4	3.657102355	1.974562792	0.000380322	0.003907
NEO1	4.774157162	2.909717718	0.000380708	0.003908
RNF34	-2.226224485	7.191882313	0.00038282	0.003926
LRRC59	2.13019561	4.892668748	0.000384273	0.003936
POLE	2.226519617	5.317313217	0.00038451	0.003936
NR3C1	-1.808042916	8.437407819	0.00038495	0.003937
EFNB1	4.818817129	1.77185775	0.000386248	0.003947
MIRLET7BHG	4.834303293	1.120609843	0.000389758	0.003977
PPARGC1B	4.652524782	1.998120379	0.000390026	0.003977
MRPS21	-1.60975294	6.134800126	0.000390238	0.003977
CTDNEP1	2.569126908	4.587634884	0.000392145	0.003993
EFR3A	1.719973837	6.184414251	0.000392873	0.003997
EMC4	-1.886833833	6.505614203	0.000393653	0.004
EXOC6B	4.765545821	2.384759536	0.000393793	0.004
TAOK2	3.433405896	3.966633405	0.000396762	0.004026
MCC	3.017759096	4.288108081	0.000397256	0.004028
ERGIC1	1.754809511	5.202344021	0.000397786	0.00403
RANBP2	1.342315026	7.490800907	0.000398467	0.004033
FNIP1	2.20617419	4.953990217	0.000402117	0.004066
EPHX1	2.699955157	3.460288153	0.000402703	0.004069

CASP10	2.730264698	3.986310814	0.00040316	0.00407
RAP2A	2.076255987	4.834242512	0.00040403	0.004075
PTPRJ	2.74381903	5.265310388	0.000404455	0.004076
APPL1	1.406782306	6.094594682	0.000405483	0.004083
DDR1	5.181651588	1.174283631	0.000405971	0.004084
CHI3L2	6.101025684	1.655981802	0.000406423	0.004085
MLLT6	1.590676298	7.778559885	0.000407059	0.004088
RBM12	1.84722579	5.990986381	0.000408216	0.004096
PSMD4	-0.968801671	6.754973299	0.00040916	0.0041
DTX3L	1.269502708	6.952142502	0.000409318	0.0041
SEMA6A	3.437504619	2.109298895	0.000410537	0.004109
LMNA	3.187507393	6.219026589	0.000412367	0.004123
LINC00324	-3.19777527	4.865611386	0.000413025	0.004126
TCP1	-0.943931009	7.797194965	0.000414593	0.004138
C19orf68	2.989118346	1.972455094	0.000416581	0.004155
LOC729603	5.297326289	0.458420166	0.000418026	0.004166
RSL1D1	-1.201704492	7.590151561	0.000418781	0.00417
ZNF621	2.408696027	4.697163884	0.000419836	0.004176
CCDC101	-1.969944202	5.021231904	0.000420988	0.004176
PVRL3	4.486754818	1.49774285	0.000421048	0.004176
EMC7	-1.969448505	6.15812839	0.000421363	0.004176
TPRN	4.099576479	0.440377694	0.000421504	0.004176
TROVE2	-1.499510564	7.250586764	0.000421632	0.004176
AUTS2	2.178291547	5.457362439	0.000422552	0.004182
GIMAP2	-3.001342623	7.210040059	0.000423813	0.004191
RANBP3	1.690585491	4.651764977	0.000424534	0.004194
SPCS2	-1.846411108	6.092377791	0.000425037	0.004195
DHCR24	3.981882204	4.070508134	0.000425349	0.004195
CEBPB-AS1	5.190229378	2.786511633	0.000425635	0.004195
MAPKBP1	2.875359406	4.827944906	0.000426724	0.004202
TNPO1	1.705767571	6.711194232	0.000427064	0.004202
RASSF4	4.414631868	3.781351861	0.000428431	0.004211
KLHDC10	1.94338957	4.927640243	0.000432735	0.00425
ACSL1	5.645408171	3.803002107	0.000433801	0.004257
SBDSP1	-2.040301319	5.550203903	0.000434535	0.004261
KCNJ13	5.096874463	0.789648222	0.000437647	0.004288
CFD	5.275434531	1.740340991	0.000438609	0.004291
TONSL	5.180665279	1.648468221	0.000438706	0.004291
SLAMF1	-1.727542604	6.465272818	0.000440392	0.004304
LMTK2	1.700143803	5.044951449	0.000440972	0.004306
MAFF	4.88442709	1.919787838	0.000441469	0.004307
HECTD1	1.455749251	7.278169283	0.000443527	0.004323
ELF1	-1.648427994	8.211121032	0.000444936	0.004333
CHAF1A	4.683408372	2.424509069	0.000446775	0.004348
SERPINH1	4.870342683	3.019399861	0.000447701	0.00435
JUN	6.011056215	3.321700008	0.000447799	0.00435
SDHA	-1.373594653	7.61522022	0.00044838	0.004352
PKMYT1	4.753152851	1.660596299	0.000450256	0.004367
ELMO2	-1.868788789	7.358841389	0.000451293	0.004373
FOSL2	4.241996524	5.230049172	0.00045191	0.004376
AP5B1	2.069318846	5.279804748	0.000452304	0.004376
SLC16A3	3.917150821	2.307599338	0.000452777	0.004377
EVA1B	4.670495589	1.29876599	0.000455591	0.004395
UHRF1BP1	3.771995146	4.119106252	0.000455808	0.004395
PHF2	2.51736783	3.866585436	0.000455853	0.004395

DGUOK	-1.777325244	6.071526879	0.000457309	0.004406
RBMS2	2.632990219	4.224952407	0.000459473	0.004422
CAP1	-1.448166434	9.680754459	0.000460412	0.004422
THYN1	-2.695826152	6.282025516	0.000460562	0.004422
SMCR8	1.865509855	5.594321608	0.000460862	0.004422
ZNF264	1.728710989	5.720572575	0.000460917	0.004422
PTAR1	1.281587182	5.602405638	0.000462292	0.004432
ZNF266	-1.428309574	7.074179521	0.000462778	0.004433
LTBP2	4.870874274	2.797478577	0.000464113	0.004438
ARID4A	-1.121886543	6.797892986	0.000464132	0.004438
B4GALT1-AS1	4.727575402	1.283618894	0.000466155	0.004454
GLS	1.330777539	7.120523097	0.000466671	0.004455
EPN2	3.970789221	2.526416314	0.000467294	0.004458
TP53I3	3.260702013	2.178156218	0.000467657	0.004458
FOXP1	-2.234092435	8.497856363	0.00046834	0.00446
ADIPOR2	2.486523775	4.570446337	0.00047271	0.004498
ST3GAL1	-1.258480764	8.2260431	0.000473471	0.004502
FAM91A1	3.155171004	4.816199759	0.000478098	0.004542
GFOD1	4.888862217	2.143997883	0.000480116	0.004558
CCNK	1.570856096	4.29479541	0.000480952	0.004562
TMEM219	-1.251834035	6.355604114	0.000482906	0.004577
SNRPA1	-1.591411389	6.058951681	0.000483959	0.004583
VPS29	-1.154847321	6.427155502	0.000486426	0.004602
TMEM50B	-1.286142826	6.828830656	0.000489063	0.004624
EAPP	-2.481115345	6.11617603	0.000489495	0.004624
SDHD	-1.455813462	6.881171642	0.000490649	0.004629
MT1E	4.643606773	0.904835301	0.000490811	0.004629
S100A8	5.723873305	1.589127244	0.000492292	0.004639
CSNK2A2	2.806251291	3.449554728	0.000492688	0.004639
USP24	1.412945786	7.39899363	0.00049447	0.004652
OPA1-AS1	4.287957927	0.684380149	0.000498208	0.00468
SIN3B	4.056932744	3.612360261	0.000498213	0.00468
TOM1L2	2.303451623	4.509588375	0.000500162	0.004694
SETD8	2.22640741	3.858445965	0.00050394	0.004726
CASP6	-2.153343029	5.037436958	0.000505887	0.00474
PPP1R12A	-1.434637227	8.300884852	0.000506588	0.004743
HSD17B12	1.594184356	4.849211155	0.000507036	0.004743
HMCES	-1.355334736	6.54205368	0.000510339	0.004766
UBP1	1.422852122	6.151655111	0.000510504	0.004766
CHD6	1.145608549	6.302407636	0.000510638	0.004766
PHKG2	-1.799525571	6.268511012	0.000511899	0.004773
TECR	-2.06806111	6.439011571	0.000513748	0.004787
MBNL3	3.224956368	4.652107134	0.000514656	0.00479
CDKN1A	5.279949707	3.531473762	0.000514919	0.00479
FCER1G	3.400384101	1.761601006	0.000517732	0.004811
MAP3K10	4.710705737	1.146094359	0.000518343	0.004811
KDM1B	3.628051068	2.71263992	0.000518451	0.004811
STAT4	-1.916024348	7.439074423	0.000519588	0.004818
FEZ2	2.959814352	3.410065348	0.000520908	0.004827
ATRN	3.13257425	4.406296681	0.000526579	0.004875
BCL3	3.231526135	4.096089756	0.000528941	0.004893
MREG	3.161840111	3.345695032	0.00053061	0.004905
RASGEF1B	3.780398941	3.615987815	0.000531148	0.004906
PSMD9	-1.548723145	6.092737148	0.00053258	0.004915
USF2	3.560823794	3.462941699	0.000533808	0.004919

ZFAND6	-1.479632969	6.79014995	0.000533819	0.004919
PTGES3	-0.931814388	7.896790361	0.000535037	0.004926
TRAPPC4	-2.110606775	5.75062483	0.000536023	0.00493
PTPN1	1.043754386	6.152054653	0.000536274	0.00493
PDCD11	1.160256835	6.336187473	0.000542172	0.00498
ATP5B	-0.73589638	9.287409493	0.000544254	0.004994
IMP4	-1.433406048	5.86676915	0.00054462	0.004994
B4GALT3	-2.261936865	6.779804739	0.00054936	0.005032
XRCC3	4.444449162	2.953400994	0.000549551	0.005032
TMEM71	-3.201971354	4.970683165	0.000551109	0.00504
SARNP	-1.534642399	5.82979645	0.000551303	0.00504
ITPR3	1.12611436	7.51595002	0.000552487	0.005047
RAD21-AS1	2.745315091	0.808471966	0.000556721	0.005077
SMURF2	2.090520532	5.250486346	0.000556725	0.005077
FAM120C	4.724788662	1.59212892	0.000560022	0.005103
PRNP	-0.907013644	8.032676837	0.000560667	0.005105
MOB1B	4.095600803	2.978335856	0.000564583	0.005128
LINC00944	-3.521671252	2.747922399	0.000564628	0.005128
CDCA8	5.331150377	1.420028886	0.000564698	0.005128
RPA1	-1.155268055	7.861602342	0.000565266	0.005128
TAX1BP1	-1.179017421	7.952044438	0.000565312	0.005128
BECN1	-1.233525288	7.322599373	0.00056767	0.005145
PKP4	3.157478013	3.518819987	0.000568592	0.005147
SUPT20H	-1.10302855	6.569422733	0.000569198	0.005147
IPO7	2.28482571	5.952629258	0.000569394	0.005147
ZNF407	2.071013863	5.01884994	0.000569846	0.005147
FBXO7	-1.038417785	7.325116145	0.000570157	0.005147
CC2D2A	4.290660508	0.46976743	0.000570619	0.005148
MED4	-1.712805236	6.618829731	0.000572891	0.005164
RFC3	5.128429812	1.843309568	0.000574135	0.005171
MTOR	1.45468616	6.352227692	0.00057531	0.005178
SF3A3	-1.288293555	7.236513657	0.000579201	0.005209
TMEM243	-1.849943006	5.667877937	0.000581876	0.005229
CAPNS1	1.676959521	5.864715493	0.000587812	0.005276
ZNF582-AS1	-3.455268426	2.860253725	0.000588012	0.005276
RPL7	-1.053886427	6.159392447	0.000588695	0.005278
GK5	2.163603221	4.941796229	0.000590234	0.005288
GIT2	-1.035521814	7.823706402	0.000590979	0.00529
CREB3L2	2.035136558	5.942537047	0.000591677	0.005292
ICAM1	3.158784154	5.142429082	0.000593375	0.005303
TESPA1	-3.523862357	6.33281935	0.000594717	0.005311
MBNL1-AS1	1.810397838	4.557625256	0.000595426	0.005313
SYNC	-1.363027351	7.103901927	0.000596127	0.005313
ATP6V1F	-1.19840977	6.344011295	0.000596332	0.005313
EEA1	2.377350571	4.869986581	0.000600094	0.005343
KCNC4	4.73737195	0.792234539	0.000601282	0.005349
MTA2	2.995960614	5.276147393	0.000602083	0.005352
AGO2	3.40881849	4.03948573	0.000610938	0.005423
ABL1	3.318924429	5.143720249	0.000610983	0.005423
TNK2	3.985854047	3.044469067	0.00061696	0.005472
ZNF740	3.253951982	3.465466299	0.000617803	0.005475
PNISR	-1.129548436	7.883586792	0.00062202	0.005509
PCNT	1.713416407	6.490398116	0.000626646	0.005541
AGAP2-AS1	4.71770435	2.01177425	0.000626674	0.005541
PDE1B	4.5384712	1.188535412	0.00062771	0.005546

SUSD6	1.390341715	6.804587449	0.000635852	0.005614
UROD	-1.629540888	6.278141592	0.000637775	0.005624
RAC2	-1.280397094	8.943604431	0.000637968	0.005624
LMNB2	5.167297553	3.505493199	0.000640788	0.005645
WDR26	1.513803017	6.915393275	0.000642152	0.005652
ABT1	-1.948400637	6.596475216	0.000649564	0.005713
SLK	1.160338478	6.858682626	0.000653441	0.005742
CASKIN1	3.843559598	1.247153897	0.00065383	0.005742
CCR8	-4.688182177	3.873385595	0.00065442	0.005743
IL32	-1.3765761	9.598711129	0.000656399	0.005753
FBXL17	3.15984714	3.600581272	0.000656542	0.005753
TCF7L1	4.282673548	0.600539077	0.000658732	0.005767
PSMD13	-0.953034312	7.178332994	0.000659568	0.005767
RAI1	4.049906505	3.382419758	0.000659691	0.005767
LIMD1	1.802534132	4.976884694	0.00066308	0.005793
SDF2	-2.100474075	5.8496501	0.000665216	0.005807
ADGRL1	4.349983104	2.334065294	0.00066812	0.005828
FOXO3	1.42441742	6.01718999	0.000672404	0.005861
HMGCS1	2.224522665	4.923516782	0.00067289	0.005861
RPS9	1.08939953	7.79161342	0.000675642	0.00588
THAP1	-2.159395704	4.509582848	0.000677521	0.005892
PVRL1	5.358852077	1.666116454	0.000679207	0.005903
ZNF117	4.425627771	1.998438201	0.000680523	0.00591
MNDA	5.800853752	1.097806064	0.000684452	0.005936
TUG1	1.226346283	7.241061058	0.000684637	0.005936
TBKBP1	4.090851801	1.783939798	0.000685644	0.005941
LILRB1	5.316791397	2.215329113	0.000688333	0.005956
CCDC71L	3.620447722	2.953455472	0.000688457	0.005956
RNASEH2C	-1.025927899	6.409259606	0.000689503	0.005957
EHBP1L1	5.501570446	3.74056734	0.000689595	0.005957
GALNT1	1.632183533	5.881375998	0.000690146	0.005958
PARP14	1.696499586	8.212040644	0.000693018	0.005978
KDM5C	2.617094986	5.893400998	0.000700554	0.006034
RSU1	-1.052309703	7.087952475	0.00070062	0.006034
SAMD1	3.378289773	1.490902168	0.000702695	0.006048
NCBP2	-1.421193965	7.090215561	0.000706502	0.006076
PLEKHH2	5.088577401	1.37626347	0.000708158	0.006086
SUSD1	4.915640669	2.29575017	0.000711109	0.006107
PPP1R12B	3.16759408	4.595874451	0.000713431	0.006122
ZNF830	-1.893784661	5.377568495	0.000715955	0.006139
TMEM181	1.296441534	5.862214428	0.000716913	0.006143
GCHFR	-3.309780915	5.340450088	0.000717481	0.006143
TIMP1	1.431770233	6.32909341	0.000717947	0.006143
NBEA	4.89897704	0.81842087	0.000718812	0.006143
BIRC6	1.215332509	8.429946105	0.000719056	0.006143
ARAP2	1.381472909	7.128543867	0.000721241	0.006149
HLA-DQB2	3.633123691	2.831617534	0.000721297	0.006149
FAM103A1	-2.092636158	3.763594394	0.000721369	0.006149
INAFM1	3.966160237	0.617641369	0.000732964	0.006244
UBAC2	-1.270176853	7.087998925	0.00073372	0.006245
HLA-DPA1	1.588993828	8.511458581	0.000737083	0.00627
NDUFA6	-1.922499521	6.008374754	0.000739266	0.00628
LSM10	-1.943078424	5.408408445	0.000739358	0.00628
SACS	1.74769308	5.969336863	0.000740144	0.00628
CCNF	3.090068411	3.843213969	0.00074045	0.00628

KIAA1147	1.28384607	6.559671633	0.000746326	0.006325
C18orf54	4.647614457	1.529524652	0.000747118	0.006327
ELK4	1.462637203	6.900791132	0.000747661	0.006327
IL6ST	1.768048272	6.824411225	0.000748401	0.006329
RSBN1	-1.18377805	6.598468022	0.000749684	0.006335
KIAA0895L	4.611792393	0.769055755	0.000755551	0.00638
RAB29	-1.684507449	7.090559352	0.000756252	0.006381
KIAA0100	2.426103855	6.839526956	0.000757761	0.006389
WDFY2	2.337658464	4.621295567	0.000758865	0.006394
ACTA2	3.182427506	4.564139476	0.000759681	0.006396
PLEK	5.98358277	5.538199329	0.000760781	0.006401
POM121	1.131365732	6.368269573	0.000762052	0.006407
PLBD2	3.829304769	3.235958159	0.00077135	0.00648
VIM-AS1	2.819291172	7.600172613	0.000771837	0.00648
EIF4G1	1.711097292	7.560304353	0.000773397	0.006488
TPI1	-1.389902805	9.069060016	0.000774418	0.006492
RFX7	1.804562707	5.270055155	0.000775099	0.006493
UTP20	2.457900733	4.961948415	0.000777293	0.006507
ARHGEF11	3.935500723	3.263774893	0.0007802	0.006526
UBXN6	4.121100047	2.911561256	0.000783828	0.006552
CASP1	-1.748252376	7.13046167	0.000786518	0.006565
DNAJC19	-2.064076433	4.86218102	0.000786559	0.006565
HMGN3	-2.198634347	6.012927186	0.000789132	0.006578
LOC101927482	-3.920028153	2.972563942	0.000789173	0.006578
MYSM1	1.407116695	6.088775843	0.000791256	0.00659
TMOD2	2.687227597	3.910105728	0.000792417	0.006595
SLC45A4	4.331182393	2.452641907	0.000794219	0.006606
YWHAZ	-0.834666652	10.02943871	0.000795292	0.006609
CRAMP1L	1.795800575	4.680156695	0.000795744	0.006609
RBM26	1.011334516	6.298172561	0.000801776	0.006654
MCTP1	2.915029879	3.239051866	0.000803382	0.006663
SSR2	-1.193088268	7.889669482	0.000805013	0.006668
DLGAP4	1.642525444	5.168398997	0.000805408	0.006668
ESYT1	-1.062447302	9.030193394	0.000805683	0.006668
AFAP1-AS1	4.691223691	0.555682595	0.00080879	0.006688
ZNF76	-2.075583536	6.632037103	0.000809704	0.00669
DPYSL2	1.704120929	6.904189849	0.000810144	0.00669
IKZF2	2.942627042	5.212104799	0.00081723	0.006744
RARA	3.905565911	3.476111852	0.00082243	0.006782
SEC16A	1.310430495	7.222958898	0.000824956	0.006798
RPS27A	-1.281136662	7.320055125	0.000825513	0.006798
ZNF445	2.560196969	4.065918276	0.000826514	0.006801
MYH10	3.399925713	3.248758378	0.000833286	0.006852
MEIS3P1	5.392305727	-1.988176187	0.000842419	0.009024
IRF8	-1.921897638	11.46957644	0.000843631	0.009024
PGR	5.062509662	-1.799936351	0.000844903	0.009024
ANKRD50	1.484213543	5.196431607	0.000846632	0.009024
ITCH	-1.939112776	6.926477667	0.000846683	0.009024
MIR3198-1	4.114174638	-0.448628176	0.000846865	0.009024
AC145138.1	5.047587563	-1.191074242	0.000847512	0.009024
RPL26L1	-2.013909922	3.31957361	0.000847682	0.009024
MDFI	5.096824681	-1.937495346	0.000847854	0.009024
ZHX3	2.094451773	4.375807432	0.000847918	0.009024
RNF6	-2.12889555	6.154905009	0.00084814	0.009024
RPS17	-2.837428815	8.170196368	0.000848854	0.009026

APOM	3.77525563	1.424327706	0.000849604	0.006981
COX14	-1.772334528	4.284002999	0.00085028	0.009035
STXBP1	4.853980948	1.003898771	0.0008507	0.009035
OCIAD2	-2.8249805	5.813746664	0.0008513	0.00699
SNED1	1.945868788	5.079971429	0.000852418	0.006995
GJC1	7.916280193	0.230822097	0.000855642	0.009068
MPZL1	4.536865429	3.424690518	0.000855649	0.007016
AP3S1	-1.787042033	5.715708936	0.000855769	0.009068
HELLPAR	3.302485475	3.530348407	0.000856183	0.009068
ALDH3A2	2.724277241	3.336730213	0.000856183	0.009068
ARPC5L	-1.750225966	5.392304605	0.000856486	0.009068
AC022726.1	5.092313211	-1.625992915	0.000857599	0.009074
ARHGAP28	6.607318469	-0.565004264	0.000858737	0.009075
TRIM9	5.63900732	-0.570564741	0.00085905	0.009075
RSRP1	-1.837371802	7.299558946	0.000859238	0.009075
LOC100294362	2.538923978	4.724417202	0.000860278	0.007041
SNRNP27	-1.582585832	5.189651881	0.000860345	0.007041
PRPF38B	-0.955401563	6.89769977	0.000860545	0.007041
LINC00641	3.808398124	2.775142371	0.000861924	0.007048
BCORL1	2.332735161	3.450246996	0.000862476	0.009094
SMIM25	5.716809808	-1.580286819	0.0008625	0.009094
EMC3	-1.489109956	5.197997828	0.000863224	0.009094
BNC2	6.752750874	-0.131370684	0.000863944	0.009094
SNX6	-1.986056676	6.27781923	0.00086403	0.009094
AC245060.5	4.402507253	1.0578202	0.000865628	0.009094
KARS	-1.562059751	7.202072169	0.000865835	0.009094
TLR2	4.386994002	1.608891217	0.000865855	0.009094
TRIM47	3.500563125	2.828771492	0.000865956	0.009094
DTHD1	5.132899141	-1.235582136	0.00086637	0.009094
CTNNBL1	-1.278154104	6.386918976	0.000867341	0.007085
HEXIM1	1.215435533	5.286103565	0.000867716	0.007085
LRP6	6.160306251	0.715688641	0.000867962	0.009102
RNF213	-1.718316651	9.539213919	0.000868136	0.009102
MORF4L2	-1.678127004	6.76986453	0.00086939	0.009109
VPS13B	1.242158738	7.397425379	0.000869428	0.007094
EPSTI1	-3.616367054	5.543999972	0.000870174	0.009112
ATG13	-1.077305896	7.284093849	0.000870579	0.007098
SP100	-1.823999721	7.449351462	0.000871292	0.009118
CEBPB	6.765929872	1.659709373	0.000871958	0.009119
ZNFX1	-1.428461969	7.101997877	0.000872727	0.009122
LIMCH1	5.702168054	0.034088127	0.000874368	0.009129
SMTN	5.321204016	2.694773821	0.000874892	0.009129
AC119396.1	3.909520032	4.899277008	0.000874996	0.009129
ABI1	-1.80371285	6.969751857	0.00087554	0.009129
ATXN7L1	2.003827111	4.33006472	0.000877083	0.00914
SARM1	4.628504218	3.354724984	0.000879363	0.009147
SAMD9	-3.123163675	7.21310327	0.00087953	0.009147
COMMD1	-1.778928261	4.147447554	0.000879569	0.009147
SPATA9	6.176940346	-0.966131028	0.000880355	0.009147
CREM	-2.682940129	4.128147437	0.000880425	0.009147
HIST1H3C	6.098867131	4.374206563	0.000881936	0.009157
GTPBP2	1.209931816	5.150931349	0.000882111	0.007184
CARD16	-2.017853067	4.979978626	0.000882365	0.007184
RNF13	-1.655372284	6.597298869	0.00088291	0.009161
EFNA5	5.699644922	-0.451570302	0.000884547	0.009171

RPL21P28	-3.341748553	1.808964085	0.000884898	0.009171
USP3	-1.457759391	7.495022198	0.000885397	0.007204
RF00003	-4.996517477	-0.261650733	0.000886744	0.009181
LRP3	5.909472594	0.433967505	0.000887655	0.009181
HK3	5.62065958	-0.488260764	0.000888028	0.009181
DENND2A	6.327615308	-0.692991798	0.000888242	0.009181
ARHGEF12	2.405402404	6.335958269	0.000888492	0.009181
DDIT3	-2.801309998	3.821709064	0.000889251	0.009183
SCFD2	4.520168736	2.798412327	0.000889787	0.007235
CYP1B1	4.346851282	3.498202057	0.000890333	0.009189
SORBS1	6.115044536	0.540686871	0.000890967	0.00919
KIF21B	1.416420394	6.530658382	0.000892067	0.007248
WDR89	-1.723859493	4.747365862	0.000893249	0.009208
ID2	-1.339573162	8.188626528	0.000894422	0.007262
SLC2A10	5.749280242	0.391475044	0.000895408	0.009224
CKAP4	4.833539826	2.512021327	0.000896572	0.009231
PRDX6	-1.41452639	6.786735657	0.000897141	0.009231
SNORA71D	-4.432467498	1.360956057	0.000900433	0.009259
EXOSC1	-1.676593163	4.671876795	0.000901095	0.009261
GTF2I	2.372331734	5.27387841	0.000901794	0.007317
CYBRD1	3.328702038	4.221498512	0.000902042	0.009265
SHC2	5.767546061	-1.027344799	0.000903002	0.009269
GPR161	3.562195408	1.03558983	0.000904664	0.009281
GTF2A2	-1.992665023	5.307519572	0.000904796	0.007336
LHX6	5.60793173	-1.197498273	0.00090665	0.009295
HIST1H3F	8.791674099	3.495579764	0.000908366	0.009306
AC099494.1	4.185511124	0.18594905	0.000908763	0.009306
RNF145	1.010182791	6.391142411	0.000909192	0.007367
SNW1	-1.793083043	6.050218437	0.000909325	0.009306
KIAA0556	2.938308311	3.771958433	0.00091034	0.007371
MIR29B2CHG	1.765648838	5.311457588	0.000910403	0.009312
MASP1	6.548606899	-0.741096741	0.000913186	0.009335
MND1	6.379743269	0.302341384	0.000915002	0.009348
LOC100289580	4.728859648	1.949086446	0.000915069	0.007404
WNT3	6.175835485	-1.350705797	0.00091596	0.009352
PCSK7	-1.169949077	7.840028437	0.00091707	0.007415
SNORD94	-3.035703203	2.862833635	0.000917195	0.009355
POU5F2	2.933397396	2.530068756	0.000917618	0.009355
IGSF6	-2.196850557	5.242383094	0.000918022	0.009355
SNHG12	-2.034768636	5.151567661	0.000918492	0.009355
AKT2	2.517938608	4.313761164	0.000919443	0.007429
OXGR1	-4.504673466	-0.716565976	0.000919646	0.009362
ZNF385D	5.971017025	-0.217706259	0.000920545	0.009363
MAGI1	5.358387499	0.765891218	0.000921275	0.009363
MRPS35	-1.988076937	5.100845556	0.000921723	0.009363
UGCG	-1.945058435	10.06619116	0.00092195	0.009363
DTHD1	6.051711603	1.654911015	0.000922165	0.007446
AC068580.4	4.25517619	1.282364114	0.000922482	0.009363
ELOC	-1.932813053	4.820363215	0.000923168	0.009364
S1PR3	9.008528684	0.858756326	0.000923974	0.009365
URB1	1.879446043	4.838856444	0.000924172	0.007457
MSRB3	-2.235891775	3.47602276	0.000924373	0.009365
ST3GAL6	-2.739423809	3.137850954	0.000925869	0.009369
FOXD2	3.432932693	1.083359557	0.00092599	0.007466
SRP54	-1.823587312	5.963155766	0.000926224	0.009369

TAF12	-2.153007185	3.993266853	0.000926395	0.009369
CNPY3	-1.196578652	6.348055096	0.000926548	0.007466
CYBB	-1.936616858	9.291463158	0.000927646	0.009376
FAM213A	-2.338153044	5.520526251	0.000929221	0.009387
NBPF1	2.302912949	3.445600089	0.000930101	0.00939
OSER1	-2.118507278	6.139360717	0.000930488	0.007492
GAS2L1	5.805304326	0.250418846	0.000932339	0.0094
PRKCE	2.192944636	5.640240092	0.00093292	0.0094
ACSS3	5.4912923	-1.261059609	0.000933078	0.0094
SYNM	3.862365966	0.59797822	0.000933261	0.0094
HNRNPF	-1.26627561	8.918387375	0.000933984	0.007515
CLINT1	-1.622685505	6.958742326	0.000934676	0.009409
KIF26A	5.907931291	0.167409966	0.000936849	0.009425
CDK18	5.595457571	0.352151322	0.000937526	0.009425
ZCCHC17	-1.875636159	4.680298368	0.000937905	0.009425
NGDN	-1.867993662	5.717040063	0.000938588	0.007547
TBX1	5.420227482	-1.433177821	0.000938887	0.009429
STIM1	1.890156819	6.91465816	0.000941425	0.009444
ST8SIA1	6.288882901	0.730440569	0.00094157	0.009444
ANP32B	1.705832348	5.476011655	0.000942739	0.009444
PSRC1	5.052775247	0.127924214	0.0009431	0.009444
WNT4	6.668896932	-0.668479327	0.000943171	0.009444
SCAMP4	3.954461929	2.952938582	0.000943772	0.007583
MARCKS	4.038929967	4.663009084	0.000947369	0.009469
NMI	-2.906052663	5.09884894	0.00094738	0.009469
MAP4	1.385797865	7.039498669	0.000947574	0.009469
PEX2	-1.682560416	5.424141635	0.000947853	0.009469
TENM3	5.521713089	-1.252532217	0.000951681	0.009496
C17orf58	5.851805436	-0.057688678	0.000951693	0.009496
ZNRF3	3.937227164	1.784466692	0.000953092	0.009504
DCP2	1.292103996	6.902852327	0.000953487	0.007656
NDUFAF1	-2.238837236	4.144449663	0.000953532	0.009504
KDM2B	1.236454954	6.02291862	0.000954793	0.007661
FADS1	-1.869986724	5.98544671	0.000955776	0.009519
CNST	-1.731047354	5.551995543	0.000956209	0.009519
TXNDC12	-1.639515407	5.454510677	0.000957332	0.009525
C3orf70	5.617792567	-1.411643389	0.000958376	0.00953
DDX24	-1.269861061	7.013902837	0.000959121	0.009532
PDIA5	3.858321057	1.913979421	0.000959394	0.007693
TIMELESS	1.771439577	5.22547408	0.000961154	0.009542
ATP5IF1	-1.899058752	5.209708079	0.000962513	0.009542
CALHM6	-2.816095159	2.811262045	0.000962764	0.009542
EBF3	5.776351235	-1.149900784	0.000962865	0.009542
HECTD4	1.669705548	7.512658151	0.000963111	0.009542
LINC00854	4.21671276	0.472763289	0.000963447	0.00772
KLHL9	-1.628839751	5.966839614	0.000963906	0.009542
WDR49	1.464729853	5.436899747	0.000964234	0.009542
MFGE8	5.479135327	3.320848763	0.000964621	0.009542
HSPH1	-1.899394015	6.575018249	0.000967797	0.009563
CNTNAP3	7.220659409	-0.736565028	0.000967937	0.009563
RPL22P1	-4.097129994	-0.544768706	0.000968421	0.009563
RNVU1-4	-4.467606554	0.543240578	0.00096906	0.009564
PPP1R3C	5.11877827	-1.76745409	0.000969801	0.009566
TUBB2A	4.465582823	1.342437338	0.000970369	0.00777
ISCU	-1.72490114	5.811328382	0.000971011	0.009572

MPV17	-1.770934832	5.990909093	0.000971577	0.007775
C1D	-2.242610539	3.975329621	0.000973059	0.009572
UFSP2	-2.308637737	4.519878465	0.000973254	0.009572
SRSF3	-0.979492778	8.54464594	0.000973481	0.007784
RNVU1-6	-4.04979728	1.956434467	0.000973632	0.009572
JMJD6	-1.593468942	4.703673727	0.000974477	0.009572
JAM3	6.223887818	1.07192052	0.000974733	0.009572
CYB5B	-1.959971332	6.627836035	0.000974971	0.009572
ATP5MC3	-1.545598956	6.367659148	0.000975239	0.009572
PLEKHH2	4.566045018	1.44954053	0.000975453	0.009572
SZT2	1.424523952	6.424551455	0.000977069	0.007801
MEA1	-1.913857948	6.004335481	0.000977246	0.007801
CDK6	4.51085781	4.797145968	0.000978217	0.007801
CEP192	1.315743181	6.06563909	0.000978248	0.007801
CDH1	5.602621315	1.593781912	0.000978935	0.007801
RHOU	4.911165738	2.431737527	0.000979534	0.007801
MAMDC4	4.836846914	1.420042042	0.000981476	0.007811
ITGA1	5.135208169	1.889620271	0.000981557	0.009627
CELSR3	5.140797468	2.726625799	0.000983871	0.009639
CMKLR1	-2.728934508	7.104058397	0.00098398	0.009639
IGF2R	2.653063085	6.968642403	0.000984022	0.007826
LDLRAD3	5.569826579	-0.469519929	0.00098452	0.009639
SLU7	-1.552489597	6.895633017	0.000985104	0.007829
OLFM1	5.684024667	-0.84678416	0.000985401	0.009642
SMIM3	-2.981816858	5.216675579	0.000985972	0.009642
SAT2	-2.077267649	5.103601531	0.000986005	0.007831
HIST1H4A	4.437978846	4.445729213	0.000989055	0.009667
MMP24-AS1	4.084110285	2.082201051	0.000989237	0.007851
AL606534.4	6.328274227	-1.929352116	0.000989635	0.009667
ULK1	3.25463252	3.61281281	0.000991053	0.007856
SRF	3.24956574	4.090383565	0.000991193	0.007856
AC020891.1	5.51836036	-1.270677318	0.000991398	0.009675
KRBOX4	-2.254823317	4.976882037	0.000991833	0.007856
SUMO2	-1.69001881	6.74649038	0.00099199	0.009675
C12orf77	5.958341612	-1.724587862	0.000992088	0.009675
SLC39A14	2.559963034	4.071293215	0.000993121	0.009679
EPB41L5	4.500285687	2.369056931	0.000994936	0.007875
GPSM2	2.632727781	3.354815611	0.00099523	0.00969
EPHA10	5.93150431	-0.7799701	0.000995485	0.00969
PIN4	-2.146506621	3.517859568	0.000995919	0.00969
FAM126A	2.232493164	4.161807203	0.000996103	0.007878
MAP3K20	2.030973832	4.399194677	0.000996503	0.00969
MYO1D	4.463537738	3.248480669	0.000996748	0.007878
STRN	1.741585196	5.459315549	0.000998734	0.007889
UBE2G2	-1.099232484	7.453877132	0.000999783	0.007892
PDCD10	-2.143956351	5.488274161	0.001000108	0.00972
CENPP	2.667368343	2.71357749	0.001001402	0.007899
KIAA1671	6.428563285	1.241087526	0.001001655	0.00972
SLC38A1	-1.889080121	8.868773432	0.00100291	0.00972
NCS1	5.914291284	-0.193915932	0.001002935	0.00972
TMEM50A	-1.856224189	6.386038893	0.001003084	0.00972
AC020658.3	4.978960039	-1.827568854	0.001003337	0.00972
EP400	1.729988519	6.977217683	0.001003502	0.00972
PASK	1.823480954	4.755531692	0.001004151	0.009721
IFNGR2	1.856812348	4.579580093	0.001005132	0.007919

PNPLA6	2.179142005	4.686977325	0.001005267	0.007919
SEC11A	-1.76202029	6.112062287	0.001006582	0.009736
TMEM258	-2.149932467	5.617752809	0.001006875	0.009736
AKT1S1	3.717938648	1.877496227	0.001008387	0.007938
CXCL13	8.266498919	-1.067234932	0.001008512	0.009738
TMEM150C	5.47864958	-0.048965785	0.001009099	0.009738
ARMT1	-2.386471346	4.276833671	0.00100981	0.009738
PRKAG2	-1.715250761	5.102818908	0.001009893	0.009738
SPIN4	4.089696862	1.845026882	0.001009961	0.009738
TXNIP	-1.558786793	9.4986141	0.001010501	0.009738
ACTN1	4.651210387	3.641058915	0.001013432	0.007972
PCDHGA10	3.077523467	2.757488325	0.001015173	0.009776
ZKSCAN8	2.582499854	4.728609265	0.001015397	0.007982
MKKS	-2.055803911	5.059111359	0.001015572	0.009776
PANK2	-1.535486401	6.042905755	0.001016548	0.009776
NSUN7	5.834631994	-0.403958352	0.001017666	0.009776
U62317.5	-4.461841452	-0.918776943	0.001017735	0.009776
CCNA2	3.5247765	3.336821169	0.001017888	0.009776
PACRGL	4.559402945	0.912928138	0.001018634	0.008002
RPN1	-1.586210899	8.115598499	0.00101893	0.009781
TMC4	4.035515032	0.041099749	0.00102085	0.008014
RPN2	-1.302253536	8.278483788	0.001021003	0.009793
RASSF2	-1.518693432	8.954900299	0.001021543	0.009793
DDAH1	7.309275273	-0.966938203	0.00102189	0.009793
LINC01122	-3.621647258	-0.846217557	0.001024509	0.009813
FMO1	6.278975319	-1.006545081	0.001025914	0.009818
NDST1	3.701729842	4.382007233	0.001026265	0.009818
GCC2	-1.314575166	7.476958086	0.001028312	0.008067
BAIAP2-DT	-3.103419284	4.837459012	0.001028627	0.009836
ZC3H15	-2.082136675	6.207791247	0.001029245	0.009836
GOLGA2P5	1.601237752	4.199864241	0.001030834	0.009846
DOK4	3.408850218	1.550230735	0.001032102	0.009852
CLEC3B	5.605800447	-1.320469451	0.001033779	0.009863
MPEG1	-1.779477284	11.45668157	0.001034788	0.009864
SDHB	-1.507228643	5.38904239	0.001035027	0.009864
RPL23AP42	-3.008368223	1.253375707	0.001036084	0.009868
MAPT	4.943443007	0.791208165	0.001036259	0.008124
SEC24AP1	6.89384531	-0.434151614	0.001036849	0.009869
AFAP1	6.309402916	1.595319558	0.001037302	0.009869
NDUFB6	-2.337953852	4.390457081	0.001038098	0.009871
EPN2	6.167589379	0.793875502	0.001039463	0.009873
KTN1	-2.075936236	7.827341652	0.001039483	0.009873
DOPEY1	1.698915154	5.61143932	0.001039575	0.008145
LRRC20	3.117904593	2.115521265	0.001041107	0.009883
ARMC9	3.511836959	2.681120169	0.001042307	0.009889
C9orf3	4.677880964	1.832948036	0.001043046	0.008167
CDHR3	6.11721527	0.311603857	0.001044369	0.009898
JAGN1	-1.631314603	4.543204354	0.00104442	0.009898
PANX1	4.820453507	2.553249589	0.001047018	0.008188
ITGB3	6.006775766	-1.393719218	0.00104726	0.009918
FUS	1.330475837	7.80061016	0.001047595	0.009918
JMJD6	-1.519319747	6.110457703	0.001047609	0.008188
SOX4	4.231943208	2.14937807	0.00104785	0.008188
MCM2	2.867939124	5.296674619	0.001049028	0.009922
PDCD1LG2	5.641460415	-0.343484273	0.001049189	0.009922

PEX11B	-1.611693983	6.025059447	0.001050027	0.008199
CD53	-1.881924891	8.661831746	0.001050992	0.009933
TMPO	1.478599889	6.78570109	0.00105163	0.008206
TRAIP	2.85909557	2.4090315	0.001052939	0.009946
RPL13AP6	2.584097573	0.154288343	0.001053417	0.008215
FAT2	7.882438181	0.049357803	0.001054709	0.009952
HMGCS1	-2.373953391	6.344974808	0.001054937	0.009952
SLC7A11	-4.125406199	3.782922778	0.001055301	0.009952
ZNF429	-3.02083806	4.722730529	0.001055476	0.008221
HNRNPDL	-1.048783759	8.6193337	0.001055689	0.008221
PEG13	2.986194985	2.192939473	0.001055942	0.009953
SYNE2	1.760512514	6.921440423	0.001057483	0.009962
SCUBE3	4.212533594	1.164641409	0.001058858	0.008238
MUC19	6.227471445	1.360108653	0.001059309	0.009973
HIST1H2AJ	7.076596473	2.309085971	0.001059899	0.009974
TSC22D4	2.891370292	4.431287907	0.001059899	0.008238
RRBP1	2.370310253	4.651532271	0.001060074	0.008238
ANKZF1	-2.218665972	7.390628989	0.001060681	0.008238
ITGA9	6.140822959	1.283737375	0.001062053	0.009988
AC022146.2	6.117763018	0.136471741	0.001063211	0.009994
VPS35	-1.460860114	7.766909933	0.001063389	0.008254
NAALADL1	-2.612725768	3.546580511	0.001066012	0.008268
PTPMT1	-1.38036412	6.206112526	0.001066723	0.008268
FCGBP	6.308452336	3.511234173	0.001067895	0.008272
SLC26A2	3.278279862	4.704198734	0.001069405	0.008276
MRPL49	-1.876791441	6.903239708	0.001069903	0.008276
PSMA5	-1.113939587	6.994668558	0.001075961	0.008317
CREB3	-1.67890139	6.055562838	0.001076539	0.008317
FAM98B	2.011471474	3.737622836	0.001078764	0.008328
RGL1	3.531138958	2.964160617	0.001082884	0.008355
NIPBL-AS1	4.527769565	1.879381171	0.001084675	0.008358
BCL2	2.776863543	5.394511975	0.001084774	0.008358
ZNF316	2.241470431	4.741546555	0.001090422	0.008395
ERCC3	-1.439576262	7.055084155	0.001091056	0.008395
LIMA1	1.699625343	5.585628662	0.00109183	0.008396
ARL5B	4.192103064	1.935011006	0.001092628	0.008396
PTBP3	1.486550296	7.507640859	0.001095353	0.008412
SLAMF6	-2.353372455	7.492696641	0.001096759	0.008417
ADAMTS10	4.281614707	1.940946549	0.001099268	0.008428
RPSAP58	1.037335795	6.684685268	0.001099643	0.008428
HS6ST1	4.063783062	2.282400358	0.001102006	0.00844
INPP1	3.691219132	2.9548777	0.001105121	0.008459
GDAP2	1.42950297	5.166900376	0.001108556	0.008479
FGR	6.965844027	2.910065684	0.001109285	0.008479
HNRNPA0	1.582120074	5.678596794	0.001111246	0.008489
TP53	1.739936684	5.192207686	0.001118568	0.008539
DVL1	4.34165879	2.540774566	0.001122829	0.008566
TIGD5	4.364044487	0.628730303	0.001123833	0.008568
ANXA2R	-2.148671161	4.855523201	0.001125257	0.008573
SOX13	4.176389148	1.869409824	0.001132544	0.008623
EGLN3	4.214463046	1.880346991	0.001133481	0.008625
FOXK2	1.171701881	5.139628864	0.0011346	0.008626
MMACHC	1.777851838	2.864605664	0.001135191	0.008626
YBX3	2.824924268	4.508643435	0.001140452	0.008661
DIMT1	-1.568395889	5.815850097	0.001142317	0.008669

ARL6IP1	-1.214381935	8.284779409	0.001147143	0.0087
SIPA1L2	5.065769925	2.207119368	0.001148038	0.008701
ZBTB10	4.517071059	1.940689371	0.001150509	0.008711
NAB1	3.120689868	3.816831484	0.001150874	0.008711
NPRL2	-2.315247472	6.179703297	0.001154505	0.008733
RBM3	1.661398602	7.368069112	0.001156826	0.008745
LRRC1	4.873789214	0.911573704	0.001157718	0.008746
GNB2	4.102617388	4.168789541	0.001158829	0.008749
FKBP14	4.632299763	1.37681331	0.001161698	0.008765
SNHG19	3.089934717	0.076896408	0.001162441	0.008765
SPDYE6	2.991311825	1.163318275	0.001163224	0.008765
PDLIM7	3.284003236	2.797940908	0.001172743	0.008828
TRIM2	2.937898049	0.777039219	0.001173072	0.008828
NIFK-AS1	-1.64265884	4.947564794	0.001180417	0.008877
EXOSC8	-1.788784251	5.788904806	0.001184583	0.008902
PCIF1	-1.490163182	7.007587328	0.001185223	0.008902
SRSF1	0.963731262	7.714195508	0.001186574	0.008906
LRCH1	2.501296591	4.080645534	0.001197301	0.008981
SLC12A7	5.031980755	3.395186918	0.001199698	0.008993
VPS13D	1.511595929	7.255424106	0.001203988	0.009019
TPM4	1.557735649	7.63403007	0.001208475	0.009042
PSMA3	-1.197621016	6.654936894	0.001209221	0.009042
NEB	3.365686289	2.912601256	0.001209283	0.009042
ZGRF1	4.426197335	2.251532002	0.001211488	0.009052
ARID1B	1.102433161	6.935719692	0.001213963	0.009065
COX6A1	-1.37815893	6.375112799	0.001219433	0.0091
DBN1	5.819714024	2.944255885	0.001220175	0.0091
RASA1	1.322153447	6.381830355	0.001221865	0.009106
ZBTB26	4.760752132	0.961425529	0.001232472	0.009175
MSL3	-2.013883451	7.114263989	0.001232629	0.009175
USP34	1.021421258	8.04160624	0.001234105	0.009175
LACC1	4.729579705	1.414793281	0.001234175	0.009175
CNPPD1	-0.988101106	6.894269346	0.001246475	0.00926
GOLGA3	1.593190335	6.927124955	0.00124824	0.009267
CD79B	-2.046132416	4.31993049	0.001251731	0.009287
CNR2	4.769657223	1.312589287	0.001253347	0.009293
MYO5C	3.521047949	2.275752953	0.001254133	0.009293
NKG7	2.57306399	6.708730559	0.001255412	0.009297
PIK3R6	4.439991053	1.460705699	0.001261749	0.009338
SLC6A6	1.552445748	6.196965004	0.001265114	0.009356
FAM131B	4.575938929	1.455275393	0.001265779	0.009356
TECPR2	3.631067408	3.362738267	0.001267177	0.00936
CRSP8P	-2.145348256	3.555756902	0.001272827	0.009396
GPR82	4.655499818	1.472533123	0.001281959	0.009457
PMPCA	-1.280077504	6.742018743	0.001288606	0.009496
NEMP2	2.922090817	3.636209744	0.001288871	0.009496
FLCN	2.433868845	4.381161847	0.001290666	0.009503
UBR3	2.171076206	5.413679786	0.001293749	0.00952
LFNG	3.037368322	3.245566401	0.001295478	0.009527
CCNB1	4.076428727	1.508547173	0.00129919	0.009548
DDX19B	-1.710819825	5.917266976	0.001303472	0.009573
CEBPB	3.680035571	3.738913488	0.001306335	0.009588
OIP5-AS1	1.366495147	5.293230279	0.001307978	0.009593
SIGLEC9	4.516570211	0.976683464	0.001308659	0.009593
UBXN4	-0.661070098	7.738348742	0.001321798	0.009683

NDUFA9	-1.345389648	6.555487811	0.001323017	0.009686
CYTIP	-1.855863822	7.671053531	0.001326571	0.009703
SH3GL1	3.722586033	4.19871267	0.001327512	0.009703
SIGLEC17P	4.418226449	3.82657007	0.001327832	0.009703
PQBP1	-1.318347266	5.992619015	0.001333516	0.009739
PHLPP1	4.503318146	1.941958414	0.001337031	0.009758
SIDT2	1.406746151	5.37056188	0.001342662	0.009793
DYNLT3	-2.346187907	5.893422259	0.001344041	0.009797
GRAP2	-2.128413988	7.012015881	0.001347349	0.009815
NCKAP5L	3.794730353	2.603793929	0.001349548	0.009825
CGRRF1	-2.582851881	4.343594222	0.001357975	0.00988
DDX27	-1.518880743	6.81760721	0.001359261	0.009883
PAPD7	3.39161022	3.935989867	0.001371536	0.009966
MIF4GD	-1.865361652	6.145225724	0.001374265	0.009978
TBC1D8	4.367054539	2.077473288	0.001374857	0.009978
GRB10	4.766785393	1.146177276	0.001377255	0.009986
CAMK1	2.053037224	3.598401647	0.001377672	0.009986

Supplementary Table S9. Fusion transcripts detected by RNA-seq.

Sample	Fusion Transcript	Left Chr	Left Breakpoint	Strand	Right Chr	Right Breakpoint	Strand
AEC2	PTPRC--SLC45A3	chr1	198722476	+	chr1	205664886	-
AEC3	RIC1--PDCD1LG2	chr9	5656690	+	chr9	5569954	+
AEC3	MREG--LINC00607	chr2	215996306	-	chr2	215750417	-
AEC3	SLA2--PMEL	chr20	36641245	-	chr12	55955361	-
AEC3	UQCC1--HM13	chr20	35347164	-	chr20	31527484	+
AEC4	ACTB--MYC	chr7	5529161	-	chr8	127738248	+
AEC4	MTAP--RNF25	chr9	21818202	+	chr2	218668679	-
AEC4	KHDRBS1--JAK2	chr1	32039573	+	chr9	5080229	+
AEC6	MTAP--CDKN2B	chr9	21854870	+	chr9	22006247	-
AEC6	RAB12--CDKN2B-AS1	chr18	8624998	+	chr9	22046751	+
AEC6	EPC1--MTPAP	chr10	32378491	-	chr10	30337027	-
AEC6	C15orf57--CBX3	chr15	40561981	-	chr7	26201745	+
AEC6	FAM49B--ASAP1	chr8	129846804	-	chr8	130112322	-
AEC8	NAA25--MICAL1	chr12	112108716	-	chr6	109445529	-
AEC8	ORC3--SH2B3	chr6	87664859	+	chr12	111446753	+

Supplementary Table S10. BAC probes used to detect DNA breaks at JAK2 by FISH.

BAC probe	Chromosome	Start	End	Strand	Size (bp)
RP11-1151G4	chr9	4639959	4782903	+	142945
RP11-140C18	chr9	5189756	5365431	+	175675
RP11-635N21	chr9	5517366	5649598	+	132232

BAC probe coordinates according to reference genome GRCh38.

Supplementary Table S11. Gateway primers used for fusion gene construction.

Gateway cloning primers (5' – 3')	Donor vector	Destination vector
eGFP (negative control)		
Forward		
GGGGACAACTTTGTACAAAAAAGTTGGCATGGTGAGCAAGGGCGAGGA	pDONR221 – P1/P4	pFUSE-DEST – R1/R4
Reverse		
GGGGACAACTTTGTATAGAAAAGTTGGGTGTTACTTGTACAGCTCGTCCA		
TFG-MET (positive control)		
TFG		
Forward		
GGGGACAACTTTGTACAAAAAAGTTGGCATGAACGGACAGTTGGAT	pDONR221 – P1/P2	
Reverse		
GGGGACCACTTTGTACAAGAAAGCTGGGTTGAAACCTGATCATCTGT		
MET		pFUSE-DEST – R1/R4
Forward		
GGGGACCCAGCTTTCTTGTACAAAGTGGTTAGATCAGTTTCCTAATTCA	pFUSE-B – P2r/P4	
Reverse		
GGGGACAACTTTGTATAGAAAAGTTGGGTGCTATGATGTCTCCCAGAA		
TFG-JAK2		
TFG		
Forward		
GGGGACAACTTTGTACAAAAAAGTTGGCATGAACGGACAGTTGGATCT	pDONR221 – P1/P2	
Reverse		
GGGGACCACTTTGTACAAGAAAGCTGGGTTGAATACTGAATACCATACT		
JAK2		pFUSE-DEST – R1/R4
Forward		
GGGGACCCAGCTTTCTTGTACAAAGTGGTTAGTTCTTCAGGAGAGAATACC	pFUSE-B – P2r/P4	
Reverse		
GGGGACAACTTTGTATAGAAAAGTTGGGTGTCATCCAGCCATGTTATCCC		
PCM1-JAK2		
PCM1		
Forward		
GGGGACAACTTTGTACAAAAAAGTTGGCATGGCCACAGGAGGAGGTCC	pDONR221 – P1/P2	
Reverse		
GGGGACCACTTTGTACAAGAAAGCTGGGTATAGTCATTCACTAACACTG		
JAK2		pFUSE-DEST – R1/R4
Forward		
GGGGACCCAGCTTTCTTGTACAAAGTGGTTAACCACTTTGTGGGAAATCTG	pFUSE-B – P2r/P4	
Reverse		
GGGGACAACTTTGTATAGAAAAGTTGGGTGTCATCCAGCCATGTTATCCC		
KHDRBS1-JAK2		
KHDRBS1		
Forward		
GGGGACAACTTTGTACAAAAAAGTTGGCATGGAGCCAGAGAACAAGTA	pDONR221 – P1/P2	
Reverse		
GGGGACCACTTTGTACAAGAAAGCTGGGTCATAAGCTTCATAAGAATCT		
JAK2		pFUSE-DEST – R1/R4
Forward		
GGGGACCCAGCTTTCTTGTACAAAGTGGTTATTCTTCAGGAGAGAATACCA	pFUSE-B – P2r/P4	
Reverse		
GGGGACAACTTTGTATAGAAAAGTTGGGTGTCATCCAGCCATGTTATCCC		

Supplementary Table S12. ORF templates used for fusion gene construction.

Gene (cDNA)	ORF template (clone ID)	Source	CDS verification
eGFP	Plasmid #25899	Addgene	Sanger sequencing
JAK2	Plasmid #23915	Addgene	Sanger sequencing
MET	Plasmid #23889	Addgene	Sanger sequencing
TFG	IRAUp969G0847D	SourceBioscience	Sanger sequencing
PCM1	IRCBp5005K1813Q	SourceBioscience	Sanger sequencing
KHDRBS1	IRAUp969A1276D	SourceBioscience	Sanger sequencing

CDS, coding sequence; ORF, open reading frame.

Supplementary Table S13. Vectors used for fusion gene construction and transduction.

Vector	Cat.No. / clone ID	Source	Identity verification
pDONR221 – P1/P2	12536017	Life Technologies	Sanger sequencing
pDONR221 – P1/P4	12537100	Life Technologies	Sanger sequencing
pFUSE-B – P2r/P4	Plasmid #97185	Addgene	Sanger sequencing
pFUSE-DEST – R1/R4	Plasmid #97186	Addgene	Sanger sequencing

Supplementary Table S14. Genes affected by genomic rearrangements.

				Rearranged genes							
A	B	C	D	E	F	G	H	I	J	K	L
ABCG4	**BAZ1A**	**C10orf76**	DCHS2	**EEF2**	FAM107B	GABRB1	HAT1	IGSF21	**JAK2**	KCNH7	L3MBTL2
ABLIM1	BCL2L1	C12orf23	DENND1B	EFHD2	FAM120A	GALM	HAUS4	**ING1**		KHDRBS1	LDB2
ABR	BCL2L14	C12orf42	DGKH	EIF4EBP1	FAM49B	GALNT16	HIP1R	INPP5A		KIAA0430	LINC00271
AC004980.8	BICD2	C14orf93	**DIP2C**	ENOX1	FAM86FP	GALNT9	HM13	INPP5F		KIAA1432	LINC00598
AC090044.1	BLNK	C15orf57	DISC1FP1	ENTPD1	FBF1	GALNTL6	**HOXA13**	**ITGAV**		**KIF16B**	LINC00607
AC144449.1	BMPR1B	C9orf135	DLEU1	EPB41	FBXW8	GJC1				KPNA6	LINC00710
ACBD4	BPNT1	**CACHD1**	DLEU7	**EPC1**	FNDC3A	**GNA14**					LINC01060
ACOT7	BTAF1	CAMK2G	DLG2	**EPHB1**	FOCAD	**GNAQ**					LINC01071
ACOX1	BTBD16	CASP7	**DMXL1**	**EPRS**	**FOXK2**	**GPC6**					LINC01088
ACTB	BTRC	CBX3	DNAJC15	ERI3	**FOXO1**	GPR149					LINGO2
ADAM11		**CCDC168**	DYNC2H1	ERICH1-AS1	FRMD4A	GRID2					LITAF
ADORA2B		CCDC92			FSIP2	GRIN3A					LLGL2
ADRBK2		CCL4L1				GSDMA					LOC644919
AJAP1		CCSER1									LOC653501
ALG1L2		**CD36**									LRP10
AMN1		**CDKN2B**									LRSAM1
ANKS6		CDKN2B-AS1									
APELA		CDRT1									
ARHGAP12		CELF5									
ARHGAP24		CHEK1									
ARID1A		CHURC1-FNTB									
ARMC3		**CIITA**									
ASAP1		CLEC16A									
ASTN2		CLYBL									
ATP6V0A2		CNN2									
		CNTN5									
		COL4A1									
		COL4A2									
		COX15									
		CRY1									
		CUBN									

Rearranged genes in **bold** are implicated in human cancer according to the Network of Cancer Genes (6.0).

				Rearranged genes						
M	N	O	P	R	S	T	U	V	W	Z
MACF1	NAA25	OLAH	PADI3	RAB10	SCHLAP1	**TACC1**	UPK3B	VAV2	WASF2	**ZBTB16**
MAN1C1	NDE1	OLR1	PALM	RAB12	SECISBP2	TANGO2	UQCC1	VPS13A	WDR45B	ZBTB8B
MAP2K6	NDUFV3	ORC3	**PAN3**	RAB28	**SH2B3**	**TCEA1**	UST	VPS13D	WDR89	ZC3H12D
MAPRE1	NEO1	OXNAD1	PCCA	RAB44	SH3BP5	TCTN3			WRAP73	**ZEB1**
MARCH1	**NF1**		PCGF3	**RB1**	**SH3GL1**	TEN1				ZFYVE28
MCM3AP-AS1	NFIC		**PCM1**	RBP7	SH3RF1	TESC				ZMYM4
MCTP2	NKAIN1		PCMTD1	**RBPJ**	SIK3	**TFG**				ZNF200
MICAL1	NLRC3		PCNT	RCBTB2	SIL1	THOC2				ZNF367
MIDN	**NPM1**		PCSK2	RERE	SKP1	TMC8				ZNF664
MIR1268A	NR_040246		**PDCD1LG2**	RHBDD1	SLA2	TMEM135				ZNF664-FAM101A
MIR548F3	NR_103777		PDE11A	RHCE	**SLC16A4**	TMEM225				ZNF714
MLLT3	NR_109888		PELP1	RHD	SLC24A2	**TMPRSS11D**				ZNF737
MOB2	NUBP1		PEX14	RIC8B	SLC25A12	TNXB				ZNF79
MREG	NXN		**PFKP**	**RMI2**	SLC2A7	**TP63**				
MSANTD3-TMEFF1			PIGV	RP11-308N19.4	SLIT3	TPTE				
MTAP			PIP4K2A	RPN2	SNF8	TPTE2P5				
MTPAP			PLA2G2F	RTN4RL1	SP6	**TRIP11**				
MUSK			**PLCE1**		SPNS3	TRPC4				
MXRA8			PLCL2		SPON1	TTC39A				
MYC			PLEKHA5		SRSF7	TTLL7				
MYO16			PMEL		**SSH1**	TWSG1				
			PNLIPRP3		ST6GALNAC4	TXNDC11				
			PPP2R2C		STK36					
			PSAT1		SVEP1					
			PSMB5		**SYNE2**					
			PSMD14							
			PTAFR							
			PTPN4							
			PTPRC							

Rearranged genes in **bold** are implicated in human cancer according to the Network of Cancer Genes (6.0).

Supplementary Table S15. Rearranged genes involved in signal transduction and transcription.

Rearranged genes involved in transcription and signal transduction pathways									
A	B	C	D	E	G	H	I	J	K
ABR	BCL2L1	CASP7	DGKH	EEF2	GALNT16	HAT1	ING1	JAK2	KHDRBS1
ACBD4	BLNK	CCL4L1	DYNC2H1	EIF4EBP1	GALNT9	HM13	INPP5A		
ACOT7	BMPR1B	CD36		ENOX1	GALNTL6				
ACOX1	BPNT1	CHEK1		ENTPD1	GNA14				
ADAM11	BTRC	CHURC1-FNTB		EPC1	GNAQ				
ADORA2B		CRY1			GPR149				
ADRBK2									
ALG1L2									
ARHGAP12									
ATP6V0A2									

Rearranged genes involved in transcription and signal transduction pathways								
L	M	N	O	P	R	S	T	Z
L3MBTL2	MICAL1	NAA25	ORC3	PCMTD1	RB1	SH2B3	TCEA1	ZBTB16
LDB2	MLLT3	NF1		PCSK2	RBPJ	SIK3	THOC2	ZBTB8B
LINGO2	MOB2	NFIC		PEX14	RCBTB2	SLA2	TMPRSS11D	ZC3H12D
LITAF	MSANTD3-TMEFF1	NLRC3		PFKP	RHBDD1	SP6	TP63	ZEB1
	MTAP			PIP4K2A	RPN2	SRSF7	TPTE	ZMYM4
	MTPAP			PLA2G2F	RTN4RL1			ZNF367
	MYC			PLCE1				ZNF79
				PLCL2				
				PMEL				
				PNLIPRP3				
				PPP2R2C				
				PSMD14				
				PTAFR				
				PTPRC				

Supplementary Table S16. Gene ontology annotation (protein class) of genes affected by genomic rearrangements.

Hydrolase	Nucleic acid-binding	Transcription factor	Transferase	Enzyme modulator	Cytoskeletal protein	Receptor	Transporter	Signaling molecule	ECM protein	Ligase	Calcium-binding protein
TMPRSS11D	ENOX1	PSMD14	GALNT16	ACBD4	WASF2	PTAFR	ATP6V0A2	PLCE1	LINGO2	SKP1	PLCE1
PSMD14	NLRC3	NLRC3	ALG1L2	PLCE1	ABLIM1	BTRC	SLC16A4	PLCL2	MSANTD3-TMEFF1	TTLL7	PLCL2
ADAM11	RBPJ	RBPJ	SIK3	PLCL2	DYNC2H1	GPR149	ABCG4	HM13	SPON1	EPRS	EFHD2
NLRC3	SP6	SP6	CHURC1-FNTB	ZMYM4	ACTB	PEX14	RHCE	CCL4L1	RTN4RL1	PCCA	
PLCE1	ORC3	NFIC	HAT1	ABR	HIP1R	LINGO2	GABRB1	BCL2L1			
TPTE	NFIC	MLLT3	GALNT9	SLA2	KIF16B	ADORA2B	TRPC4	BLNK			
PLCL2	MLLT3	MICAL1	RPN2	NF1	MACF1	CD36	SLC24A2	PMEL			
DYNC2H1	MICAL1	ZNF79	DGKH	MOB2	MICAL1	PTPRC	RHD				
BPNT1	TCEA1	TCEA1	ADRBK2	GNA14	CNN2	MSANTD3-TMEFF1					
ATP6V0A2	RB1	RB1	CHEK1	CASP7	TTLL7	BMPR1B					
PCSK2	SRSF7	LDB2	MTPAP	MSANTD3-TMEFF1	MAPRE1	RTN4RL1					
INPP5A	KHDRBS1	ZBTB16	PIP4K2A	EEF2	ZBTB8B						
PNLIPRP3	EPC1	ZEB1	PFKP	ARHGAP12							
HM13	EEF2	THOC2	ACOX1	RCBTB2							
PPP2R2C	MYC	KHDRBS1	PCMTD1	GNAQ							
CASP7	CRY1	TP63	BMPR1B								
PTPRC	EIF4EBP1	MYC	GALNTL6								
EEF2	L3MBTL2	LITAF	NAA25								
PLA2G2F	RCBTB2	L3MBTL2	MTAP								
ACOT7	ZNF367	ZNF367									
RHBDD1	ING1	ING1									
ENTPD1	ZC3H12D										
ZBTB8B											

Cell junction protein	Adaptor protein	Cell adhesion molecule	Membrane traffic protein	Isomerase	Lyase	Structural protein	Storage protein
GJC1	DLG2	PMEL	LLGL2	GALM	CRY1	ABLIM1	PNLIPRP3

Supplementary Table S17. Recurrently rearranged genes in pcAECyTCL.

Gene	Number of cases (%)	Affected patients
JAK2	3 (25)	AEC4, AEC9, AEC11
MTAP	3 (25)	AEC4, AEC6, AEC10
SH2B3	2 (16)	AEC8, AEC10
CLEC16A	2 (16)	AEC5, AEC7
MYC	2 (16)	AEC4, AEC9
PTPRC	2 (16)	AEC2, AEC5
RB1	2 (16)	AEC5, AEC11
PIP4K2A	2 (16)	AEC7, AEC12
BAZ1A	2 (16)	AEC1, AEC2
DLEU1	2 (16)	AEC3, AEC7
SLC24A2	2 (16)	AEC3, AEC7
ABR	2 (16)	AEC1, AEC9
GNA14	2 (16)	AEC7, AEC10
RHCE	2 (16)	AEC7, AEC8
RHD	2 (16)	AEC7, AEC8
DLG2	2 (16)	AEC10, AEC12
FRMD4A	2 (16)	AEC11, AEC12

Supplementary Table S18. GSEA: Expression signatures enriched in pcAECyTCL when compared to skin-resident CD8+ T cells.

Gene set	Up-regulated in class	Enrichment score (ES)	Normalized enrichment score (NES)	Nominal *p*-value	FDR *q*-value
HALLMARK_EPITHELIAL_MESENCHYMAL_TRANSITION	pcAECyTCL	0.64401390	2.2286506	0	0
HALLMARK_COAGULATION	pcAECyTCL	0.6382711	2.095264	0	0.000454545
HALLMARK_MYOGENESIS	pcAECyTCL	0.6031522	2.0066237	0	0.001446354
HALLMARK_IL6_JAK_STAT3_SIGNALING	pcAECyTCL	0.5831026	1.7467761	0.002205072	0.017952897
HALLMARK_E2F_TARGETS	pcAECyTCL	0.46690926	1.6398238	0.006256517	5.41E-02
HALLMARK_APICAL_JUNCTION	pcAECyTCL	0.45786095	1.6293	0.006153846	5.11E-02
HALLMARK_G2M_CHECKPOINT	pcAECyTCL	0.43160993	1.5561363	0.015400411	9.22E-02
HALLMARK_COMPLEMENT	pcAECyTCL	0.4168388	1.4964621	0.030895984	0.13538636
HALLMARK_ESTROGEN_RESPONSE_LATE	pcAECyTCL	0.45078337	1.4946655	0.036093418	0.122473605
HALLMARK_TNFA_SIGNALING_VIA_NFKB	pcAECyTCL	0.41415706	1.4757737	0.03062302	0.12732658
HALLMARK_ESTROGEN_RESPONSE_EARLY	pcAECyTCL	0.42218003	1.4636395	0.044791665	0.12943044
HALLMARK_MITOTIC_SPINDLE	pcAECyTCL	0.38436788	1.4102231	0.066872425	0.17664509
HALLMARK_ANDROGEN_RESPONSE	pcAECyTCL	0.43390587	1.4065517	0.082706764	0.16764276
HALLMARK_INFLAMMATORY_RESPONSE	pcAECyTCL	0.39430708	1.3724854	0.101372756	0.19676246
HALLMARK_XENOBIOTIC_METABOLISM	pcAECyTCL	0.4405326	1.3615569	0.12554584	0.19602293
HALLMARK_UV_RESPONSE_DN	pcAECyTCL	0.39743572	1.2677939	0.1705757	0.31485185
HALLMARK_HYPOXIA	pcAECyTCL	0.34982967	1.2007973	0.23903966	0.41856754
HALLMARK_IL2_STAT5_SIGNALING	pcAECyTCL	0.3426043	1.1777062	0.25729167	0.4372747
HALLMARK_MTORC1_SIGNALING	pcAECyTCL	0.31544158	1.1363819	0.30103093	0.49239415
HALLMARK_P53_PATHWAY	pcAECyTCL	0.30856538	1.125719	0.32955715	0.48810208
HALLMARK_KRAS_SIGNALING_UP	pcAECyTCL	0.35575828	1.1093593	0.3522854	0.4960959
HALLMARK_GLYCOLYSIS	pcAECyTCL	0.31330192	1.0645952	0.4155983	0.55579376
HALLMARK_ADIPOGENESIS	pcAECyTCL	0.29850566	1.0148408	0.4552239	0.6171739
HALLMARK_TGF_BETA_SIGNALING	pcAECyTCL	0.30825996	0.98060656	0.5290889	0.6489524
HALLMARK_APOPTOSIS	pcAECyTCL	0.2553736	0.9178955	0.6204757	0.72608525
HALLMARK_UNFOLDED_PROTEIN_RESPONSE	pcAECyTCL	0.28946075	0.87442607	0.6599327	0.76720464
HALLMARK_FATTY_ACID_METABOLISM	pcAECyTCL	0.24334973	0.81040686	0.7457627	0.825847
HALLMARK_INTERFERON_GAMMA_RESPONSE	pcAECyTCL	0.21901207	0.7929421	0.78586066	0.8161005
HALLMARK_PI3K_AKT_MTOR_SIGNALING	pcAECyTCL	0.22495408	0.76297516	0.8036286	0.8219768
HALLMARK_UV_RESPONSE_UP	pcAECyTCL	0.22769414	0.7512874	0.79383636	0.8064818

Supplementary Figure S1. Microscopy images of H&E-stained tumor tissue from representative pcAECyTCL patients included in the study.
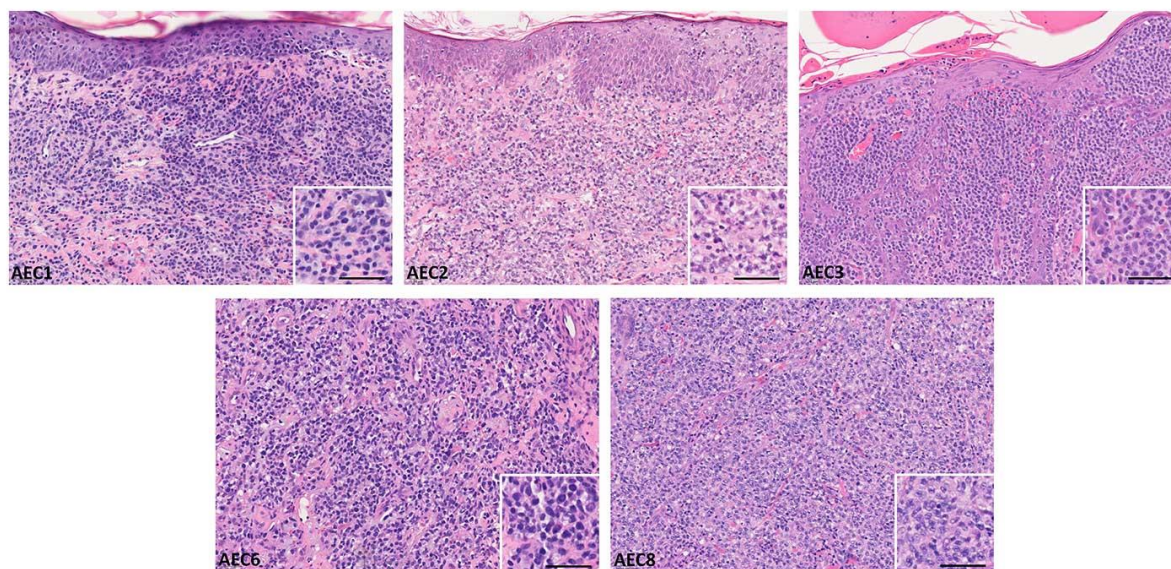
Supplementary Figure S1. Microscopy images (magnification**,** 200X) of H&E-stained tumor tissue from patients with pcAECyTCL subjected to NGS. Scale bar, 50 μM.

Supplementary Figure S2. Common focal CNAs in pcAECyTCL detected by GISTIC2.0. analysis.

A)
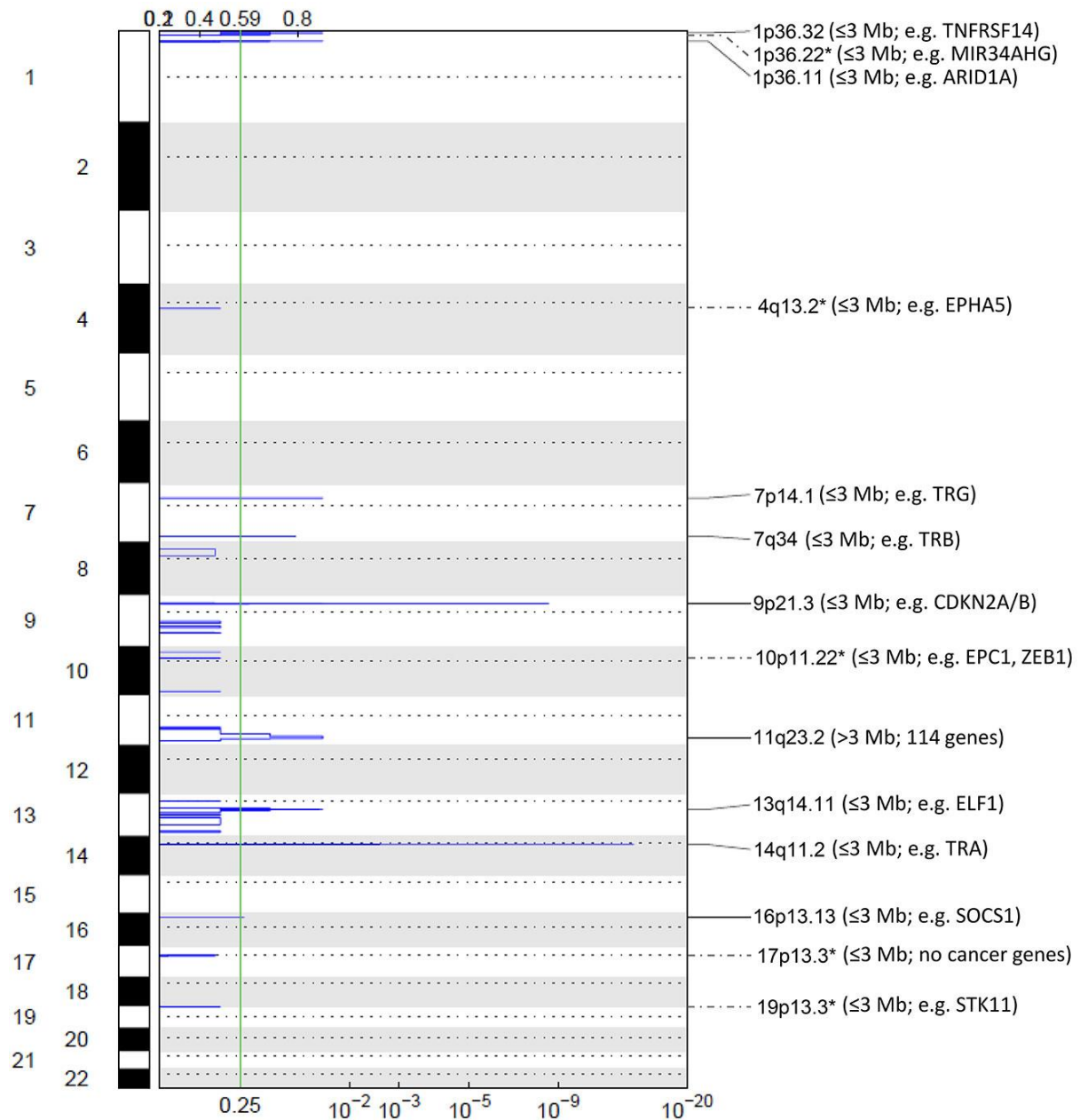
Common focal losses in pcAECyTCL detected by GISTIC2.0. analysis. GISTIC2.0 detected high confidence common losses (*q* value ≤0.25) shared by pcAECyTCL patients within chromosomes 1, 7, 9, 11, 13, 14 and 16. Peaks at 1p36.11, 1p36.32, 9p21.3, 13q14.11 and 16p13.13 were all ≤ 3Mb long (as verified with IGV) and enclosed (putative) tumor suppressors *ARID1A*, *TNFRSF14*, *CDKN2A/B*, *ELF1* and *SOCS1*, respectively. Peaks at 7p14.1, 7q34 and 14q11.2 contained loci encoding the γ (TRG), β (TRB) and α (TRA) chains of the T-cell receptor (TCR), respectively, which are rearranged during T-cell development. Loss of the exact same region within *TRA*, *TRB* and *TRG* in tumor DNA from patients suggests that pcAECyTCL is a clonal disease. Losses at lower confidence peaks (* *q* value >0.25) 1p36.22, 4q13.2, 10p11.22 and 19p13.3 were verified in patients by inspection of WGS data with IGV. These peaks contained tumor suppressors *MIR34AHG*, *EPHA5*, *ZEB1* (alongside *EPC1*) and *STK11*, respectively.

B)
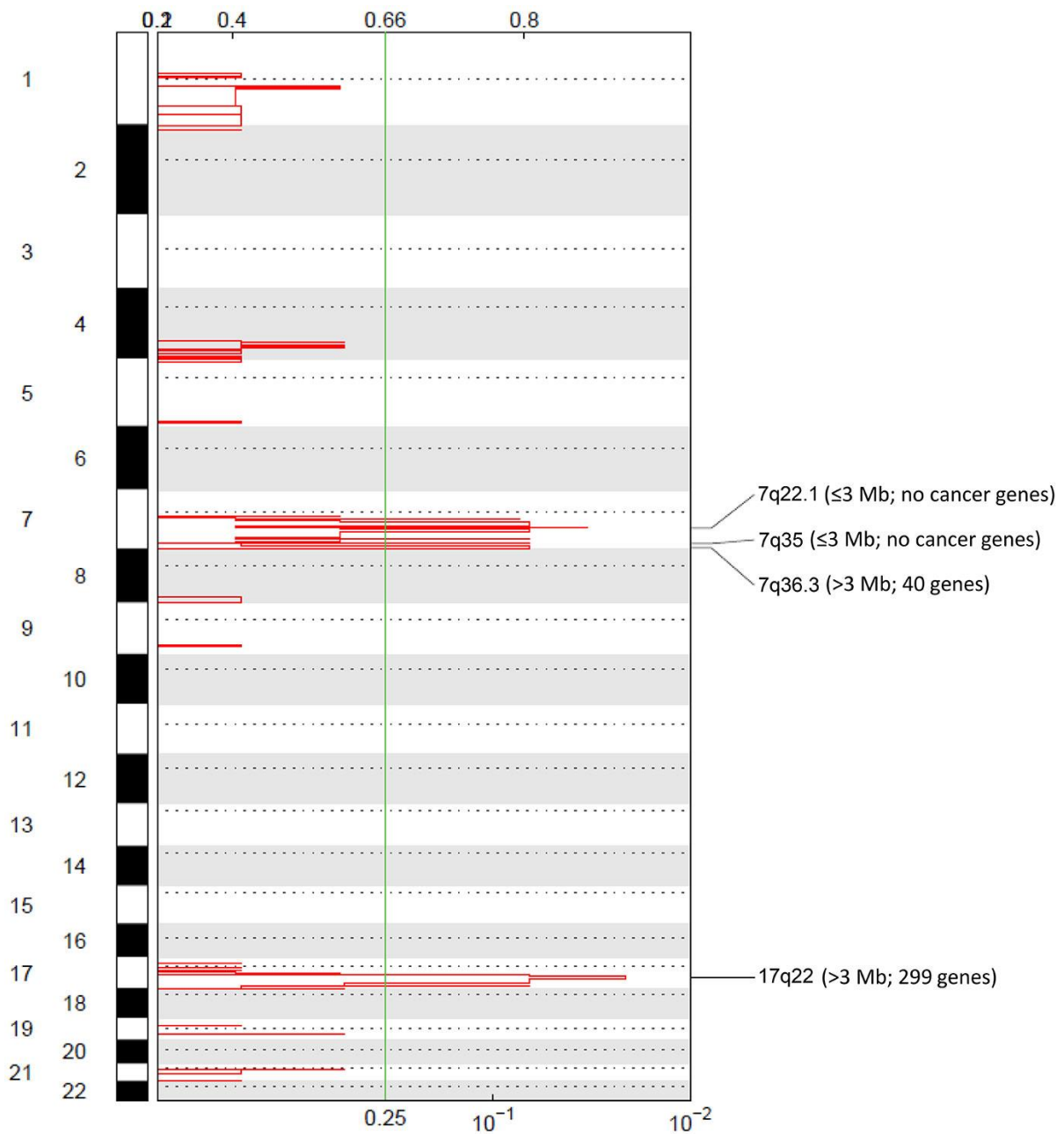
Common focal gains in pcAECyTCL detected by GISTIC2.0. analysis. GISTIC2.0 detected common gains between pcAECyTCL patients. Peaks within chromosomes 7 and 17 were either > 3Mb long or devoid of (putative) cancer genes, and consequently, excluded.

Supplementary Figure S3. Circos plots displaying recurrently altered genes in pcAECyTCL per patient.
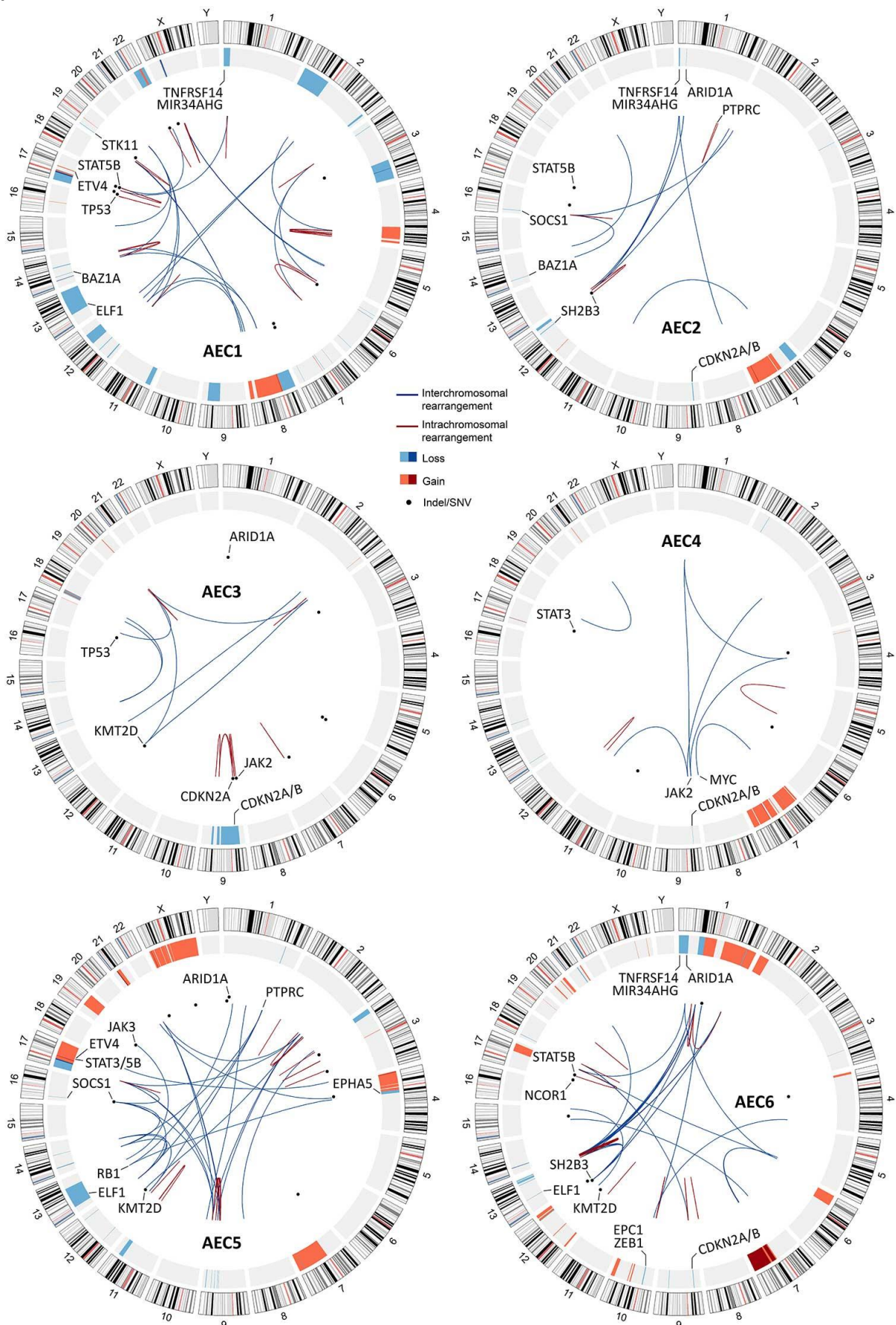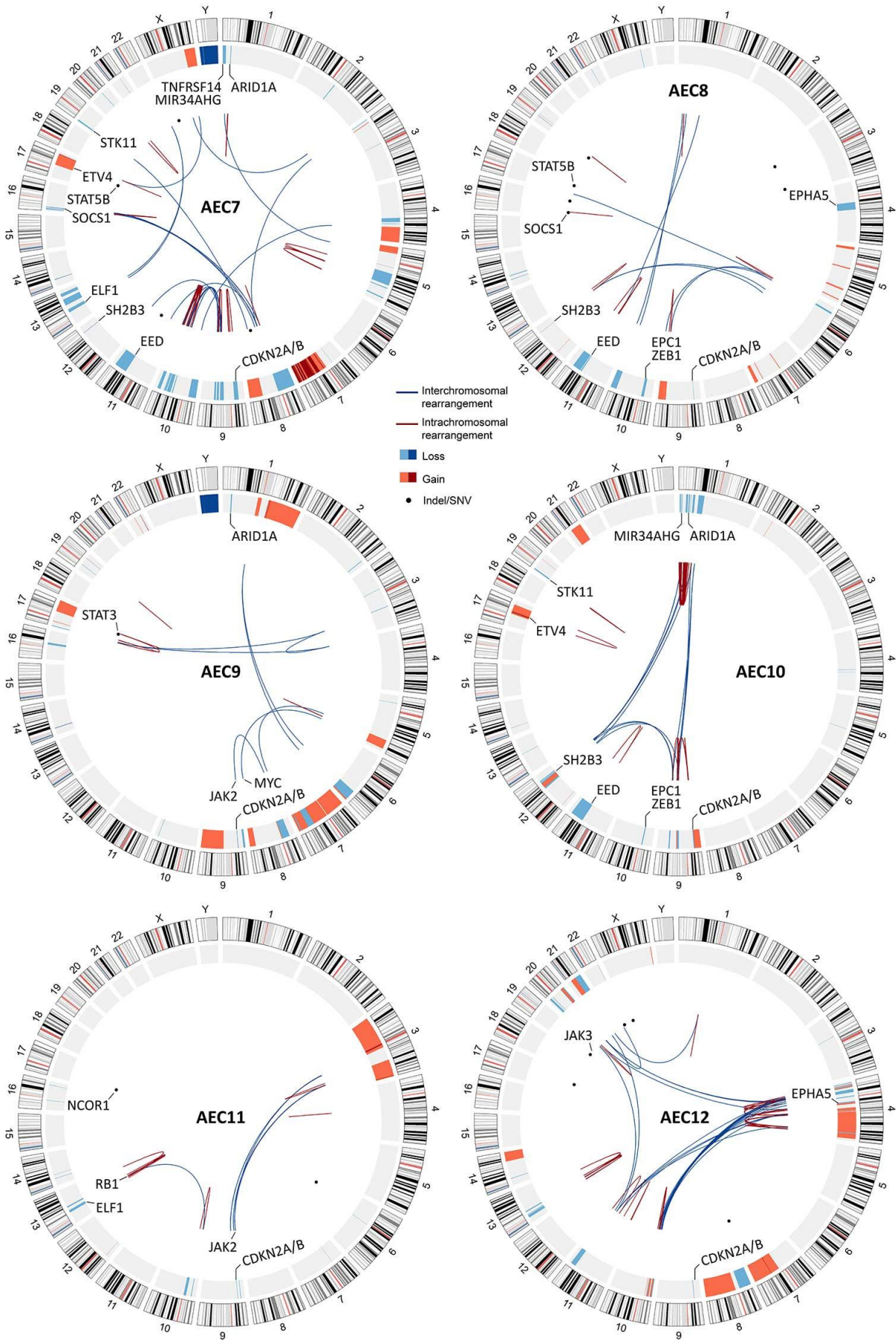
Legend on next page

Supplementary Figure S3. Circos plots of individual patients showing cancer genes found to be recurrently affected by molecular alterations (i.e. genomic rearrangements, CNAs, pathogenic indels/SNVs) in the analyzed pcAECyTCL cohort. These events predominantly affected cancer genes with established roles in the JAK-STAT pathway, cell cycle and chromatin regulation. Of note, nine of twelve patients (i.e. AEC2-4/6-11) carried mutually exclusive molecular alterations impacting the JAK2-SH2B3 signaling axis.

Supplementary Figure S4. Validation of select genomic rearrangements in pcAECyTCL by Sanger sequencing.

A)
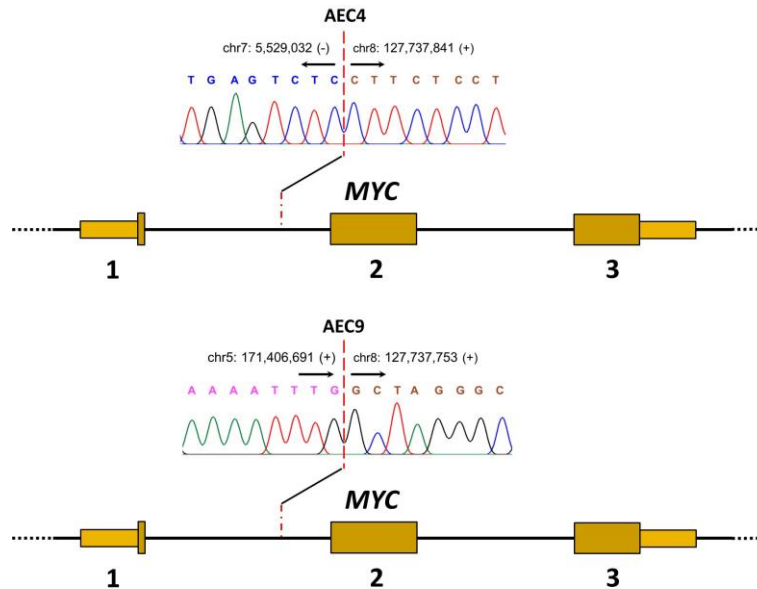
B)
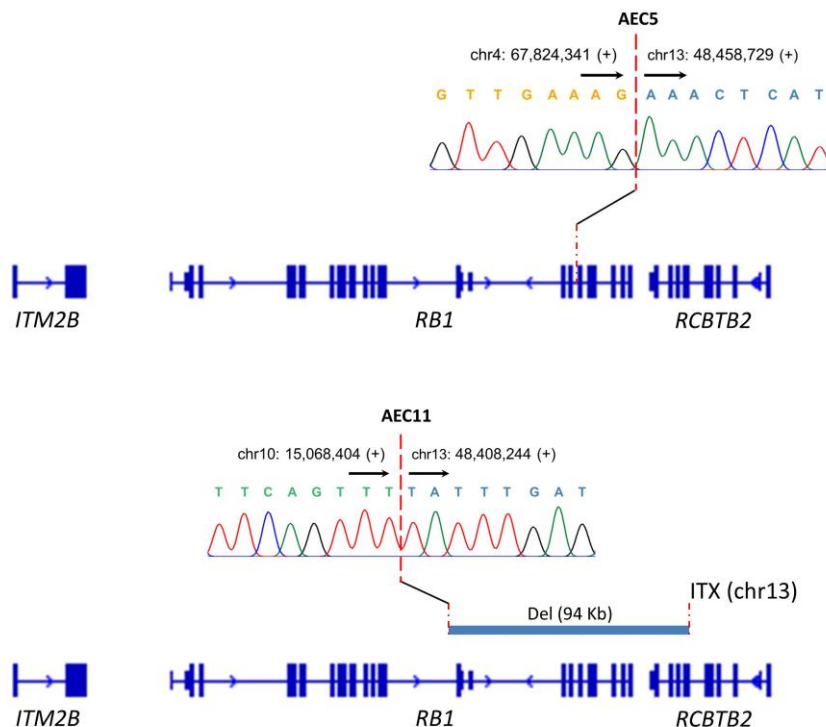
Supplementary Figure S4. Sanger chromatograms showing breakpoints of interchromosomal rearrangements at (A) *MYC* and (B) *RB1* in tumor DNA from patients with pcAECyTCL. Genomic coordinates according to reference genome GRCh38.

Supplementary Figure S5. Validation of genomic rearrangements at *SH2B3* in patient AEC8 by Sanger sequencing.
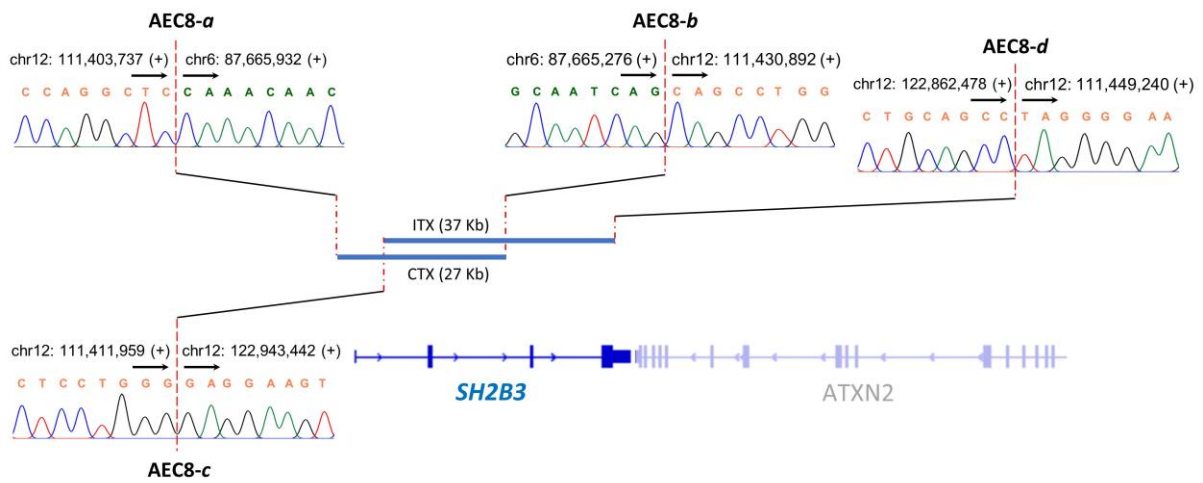
Supplementary Figure S5. Sanger chromatograms showing breakpoints of inter- and intrachromosomal rearrangements at *SH2B3* in tumor DNA from patient AEC8. AEC8 was the only patient carrying two inactivating structural events at *SH2B3* in our pcAECyTCL cohort. Genomic coordinates according to reference genome GRCh38. CTX, interchromosomal rearrangement, ITX, intrachromosomal rearrangement.

Supplementary Figure S6. Sanger sequencing validation of select SNVs.

Patient AEC2
STAT5B p.P702S
Chr17: 42,202,782
C → T

Patient AEC9
STAT3 p.G604A
Chr17: 42,323,081
G → C

Patient AEC8
STAT5B p.S434L
Chr17: 42,217,239
A → G
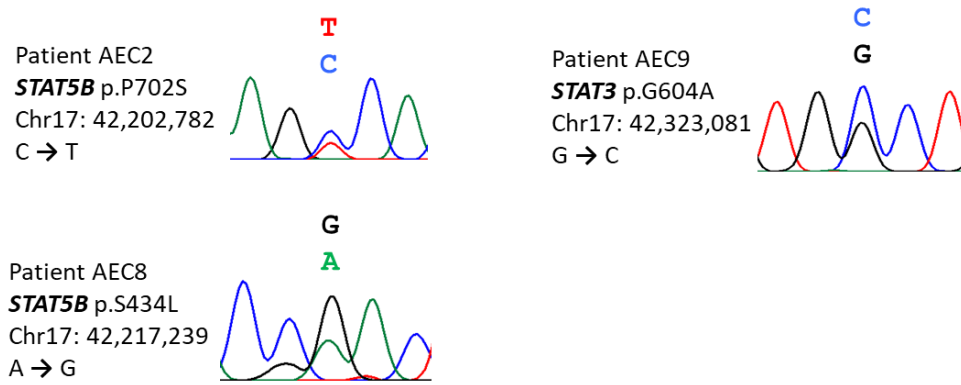
Supplementary Figure S6. Sanger chromatograms showing SNVs in *STAT3* and *STAT5B* detected in pcAECyTCL tumors by WGS and predicted as deleterious (SIFT and PolyPhen-2). Genomic coordinates according to reference genome GRCh38.

Supplementary Figure S7. Validation of *CDKN2A* loss in pcAECyTCL by ddPCR.
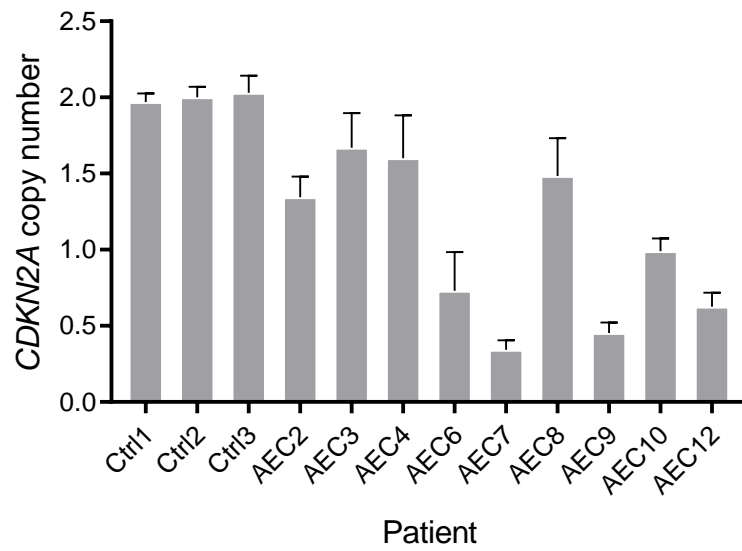
Supplementary Figure S7. Loss of *CDKN2A*, the most commonly inactivated tumor suppressor in pcAECyTCL according to the WGS data, was confirmed by ddPCR in all patients with available material. Ctrl, CD8+ T cells.

Supplementary Figure S8. Genomic location of BAC probes used in FISH experiments.
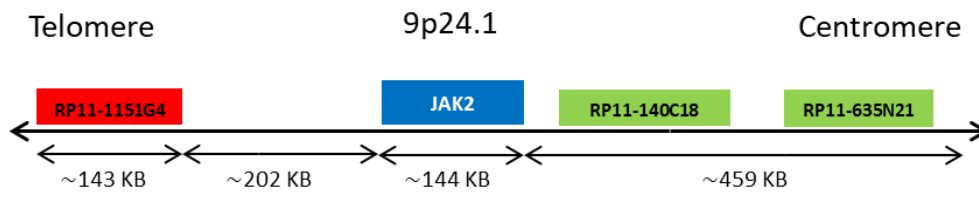
Supplementary Figure S8. (A) Diagram of break-apart BAC probes used for the validation of DNA breaks at *JAK2* (9p24.1) in pcAECyTCL. See Supplementary Table S10 for the exact genomic positions of the BAC probes used in this study.

Supplementary Figure S9. Methylation-specific melting curve analysis (MS-MCA) of CpG islands at *SH2B3* in pcAECyTCL.

A)

M = Methylated standard
NM = Non-methylated standard
NTC = Non-template control
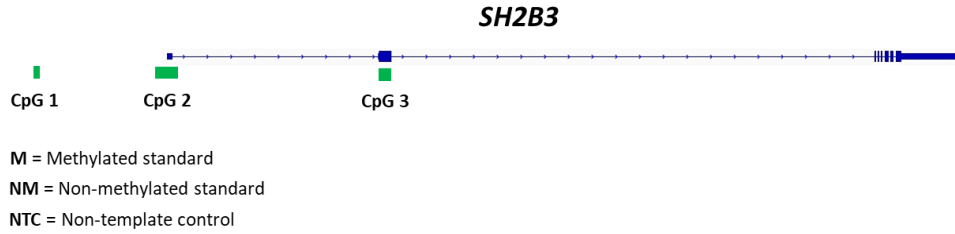
B)

CD8+ T cells (control):
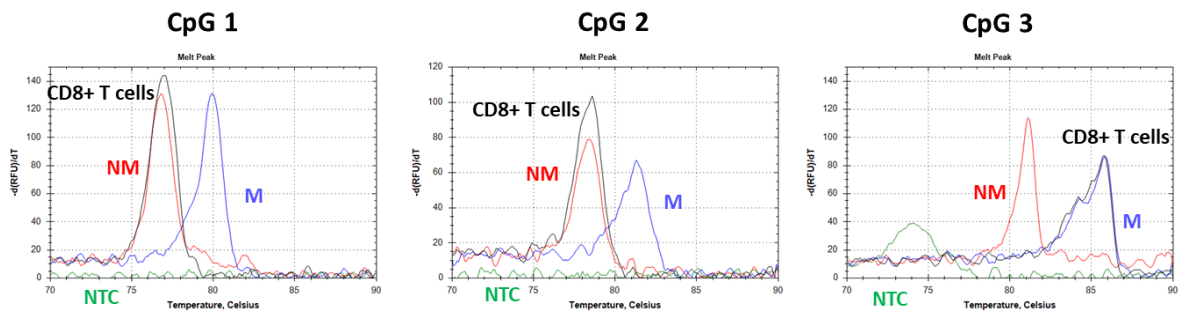
C)

Patient AEC3:
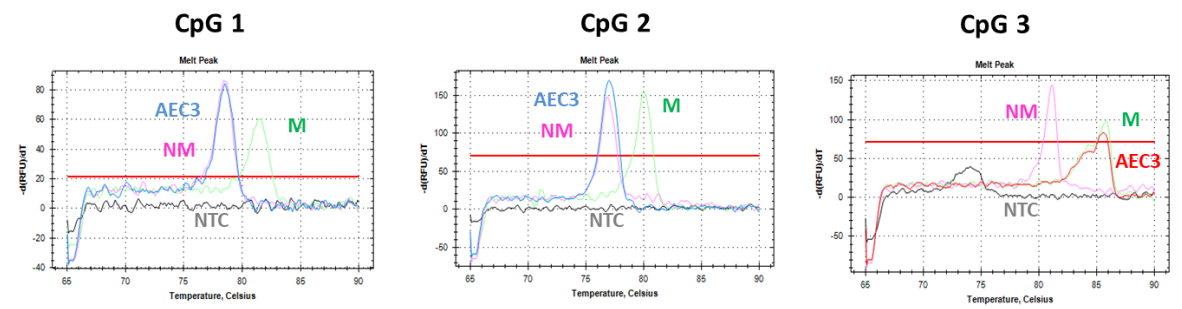
Patient AEC4:

Patient AEC5:

CpG 1

CpG 2

CpG 3

Patient AEC8:

CpG 1

CpG 2

CpG 3

Patient AEC9:

CpG 1

CpG 2

CpG 3

Patient AEC10:

**CpG 1**

CpG 2

CpG 3
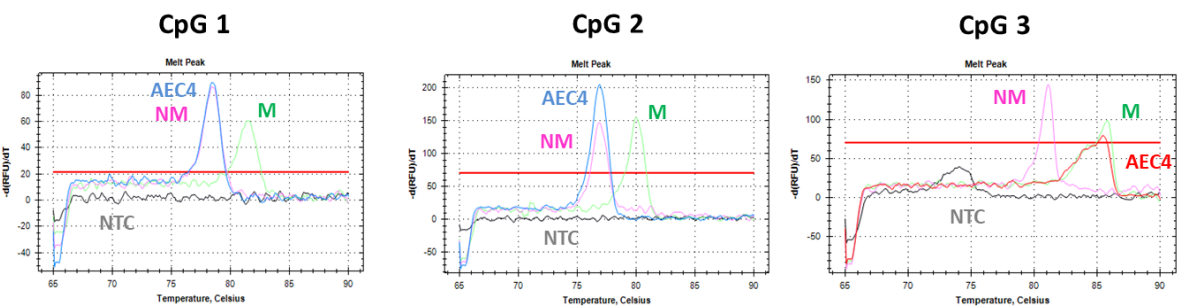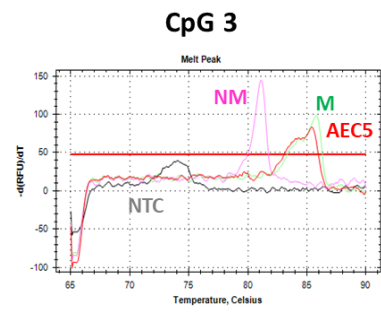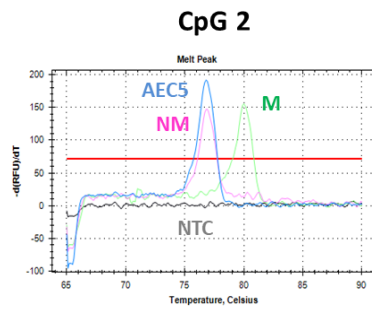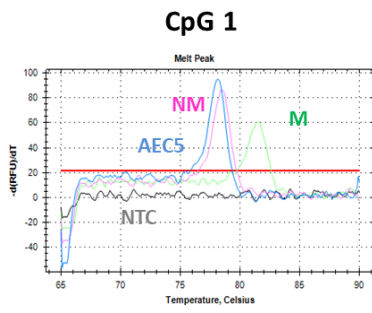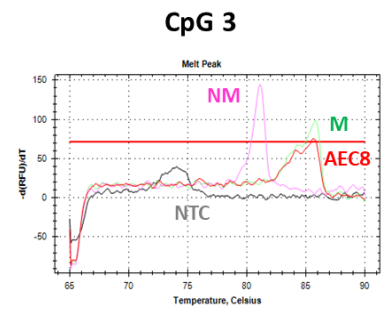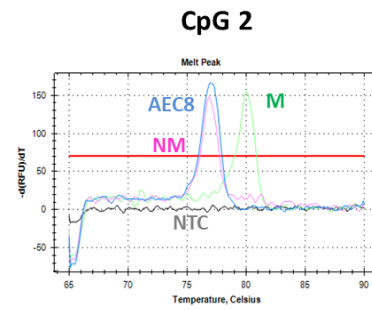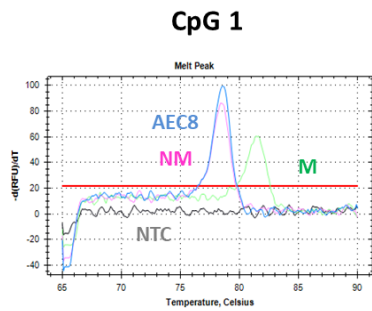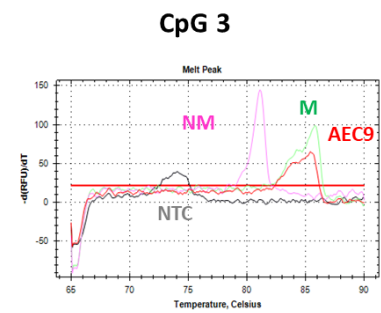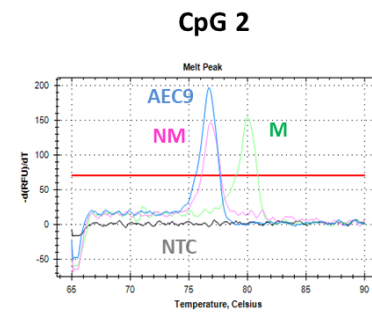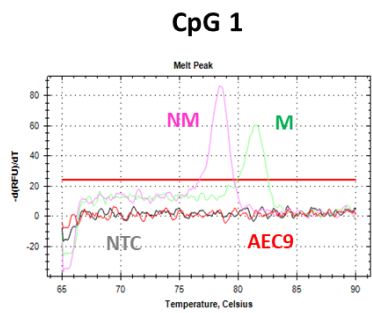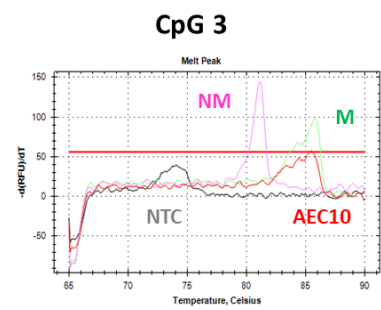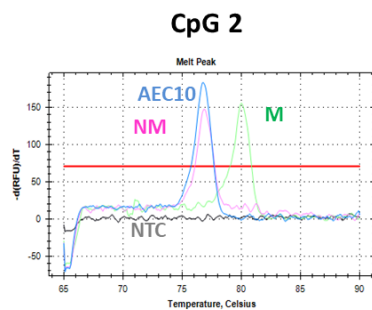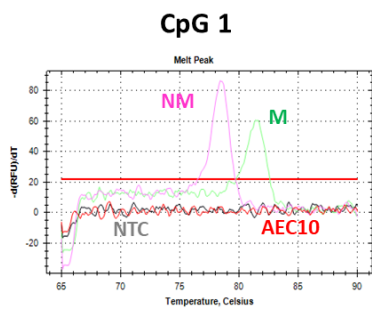
Patient AEC11:
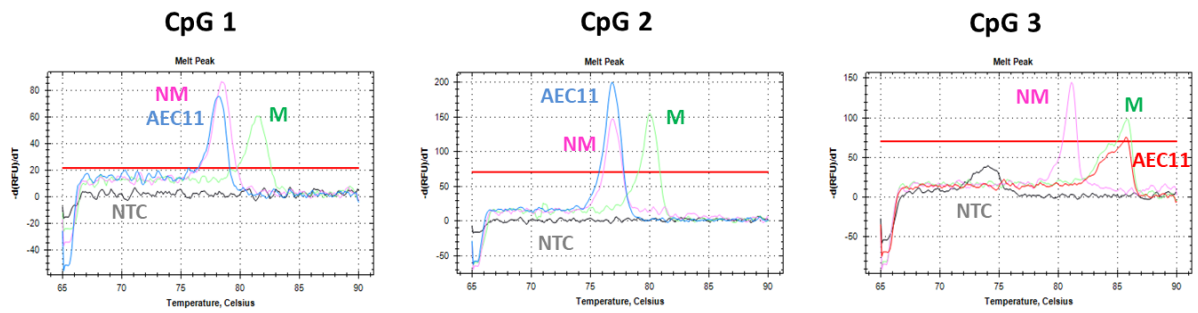
Supplementary Figure S9. A) Diagram showing the location of the 3 CpG islands near/at *SH2B3* interrogated by MS-MCA in patients with pcAECyTCL. B) MS-MCA curve profiles of DNA from normal CD8+ T cells (control). CD8+ T cells show full unmethylation at CpG1 and CpG2, and full methylation at CpG3. C) MS-MCA curve profiles of tumor DNA from patients AEC3, AEC4, AEC5, AEC8, AEC9, AEC10 and AEC11. Just like normal CD8+ T cells, tumor DNA from patients with pcAECyTCL show full unmethylation at CpG1 and CpG2, and full methylation at CpG3, suggesting that hypermethylation at CpG3 in patients with pcAECyTCL is not associated with silencing of *SH2B3*, and therefore, it is unlikely to play a pathogenic role in the disease.

Supplementary Figure S10. Complex genomic rearrangement in patient AEC7.
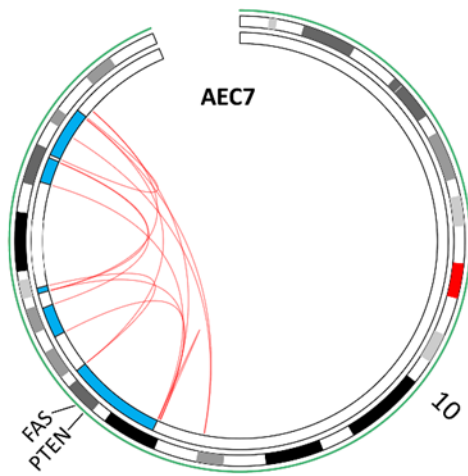
Supplementary Figure S10. Circos plot showing a chromothripsis-like event detected in chromosome 10 of patient AEC7 through WGS. This event mediated the loss of several genomic regions within chromosome 10, including the region where tumor suppressors *FAS* and *PTEN* reside.

Supplementary Figure S11. Interchromosomal rearrangement leads to high *ANRIL* (*CDKN2B-AS1*) expression in patient AEC6.
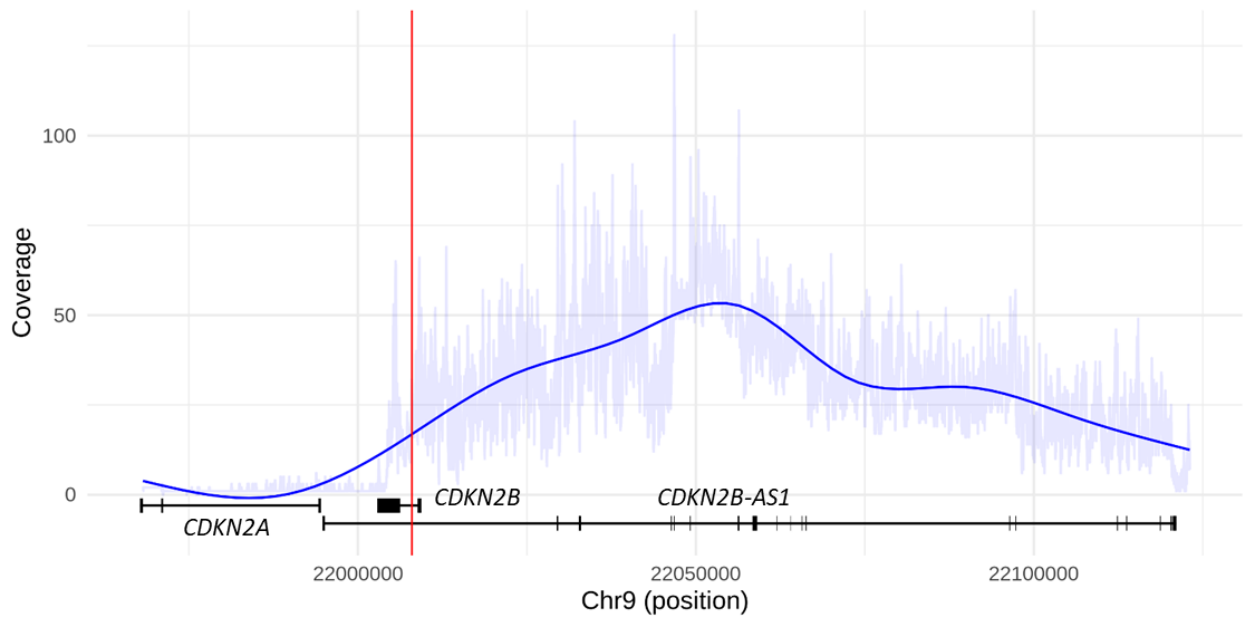
Supplementary Figure S11. Plot representing the mean read coverage (RNA-seq) across three cancer genes residing within 9p21.3: *CDKN2A*, *CDKN2B* and *ANRIL* (*CDKN2B-AS1*). Due to an interchromosomal rearrangement that fused *RAB12* with *ANRIL*, putting the latter under the transcriptional control of the former's promoter, patient AEC6 experienced high *ANRIL* expression when compared to the rest of pcAECyTCL patients where ANRIL expression was negligible (data not shown). *ANRIL* is a PRC2-dependent silencer of *CDKN2B* (p15^{INK4b}). The red line indicates the breakpoint position within the *ANRIL* locus. Genomic coordinate numbers according to reference genome GRCh38.