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Supplementary Information for

Loss of BOP1 confers resistance to BRAF kinase inhibitors in melanoma by activating MAP kinase pathway

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Fig. S1.

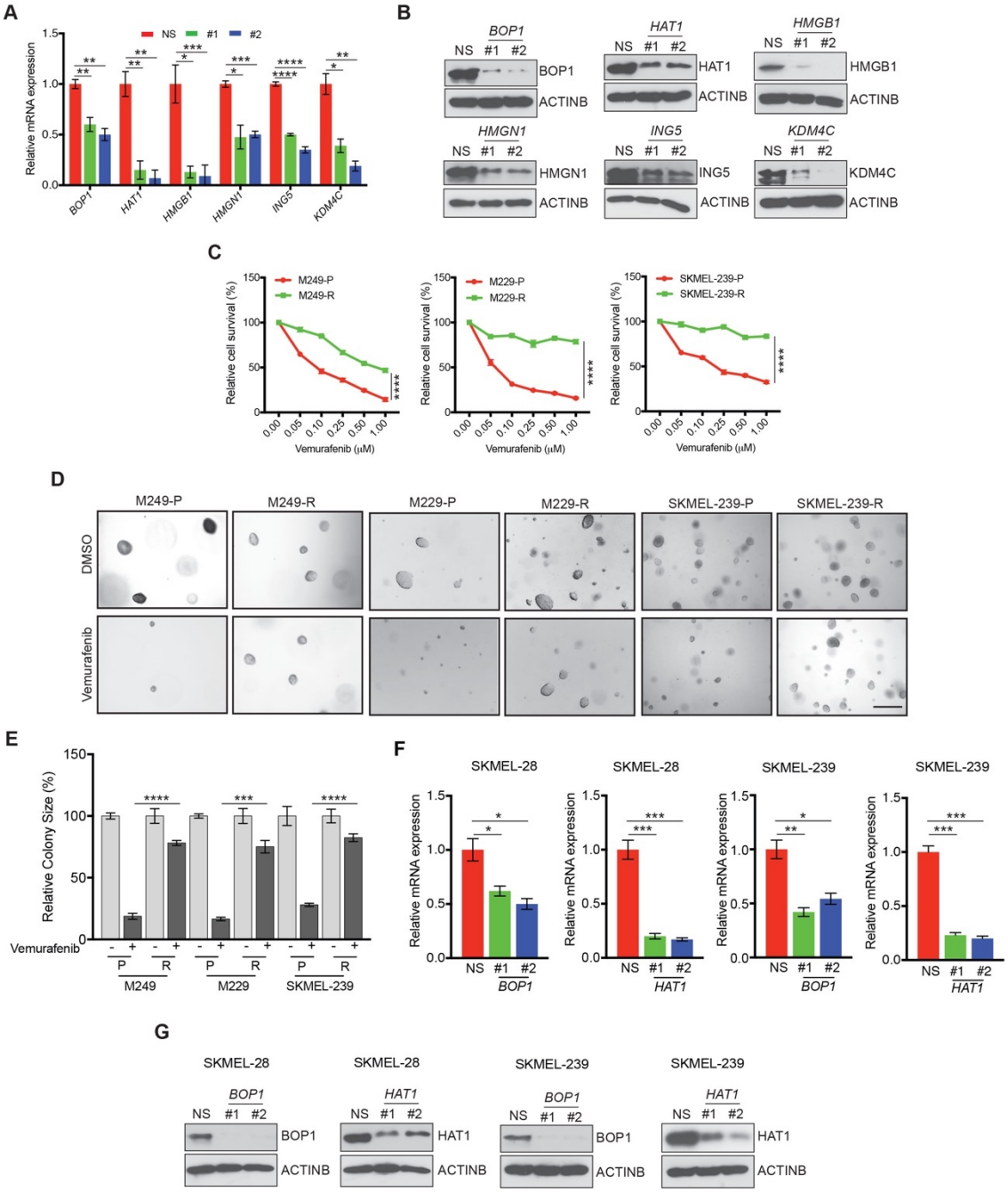

Fig. S1. Short hairpin RNA (shRNA) targeting efficiencies and vemurafenib sensitivity of parental and BRAF kinase inhibitor-resistant melanoma cells. (A) Expression of the indicated genes measured by RT-qPCR in A375 cells expressing non-specific (NS) or indicated shRNAs; mRNA expression in shRNA-targeted cells relative to NS shRNA is shown. (B) Levels of indicated proteins measured by immunoblotting in A375 cells expressing NS or shRNAs. (C) Relative cell survival (%) measured by MTT assay of indicated parental (P) or BRAF kinase inhibitor (BRAFi)-resistant (R) melanoma cells treated for 3 days with the indicated concentrations of vemurafenib or

DMSO control. (D) Indicated parental (P) or BRAFi-resistant (R) melanoma cells were treated with vemurafenib (1 μM) or DMSO control, and anchorage-independent growth was assessed by soft-agar assay. Representative images of soft-agar colonies under the indicated conditions are shown. Scale bar, 500 μM. (E) Relative colony size (%) for the soft-agar data in panel D. (F) Expression of the indicated genes measured by RT-qPCR in SKMEL-28 or SKMEL-239 cells expressing a NS or shRNAs targeting the indicated genes; mRNA expression in shRNA-targeted cells relative to NS shRNA is shown. (G) Levels of indicated proteins measured by immunoblotting in SKMEL-28 or SKMEL-239 cells expressing NS or shRNAs against indicated genes. ACTINB was used as a loading control. Data are presented as the mean ± standard error of the mean (SEM). **P*<0.05, ***P*<0.01, ****P*<0.001, and *****P*<0.0001.

Fig. S2.

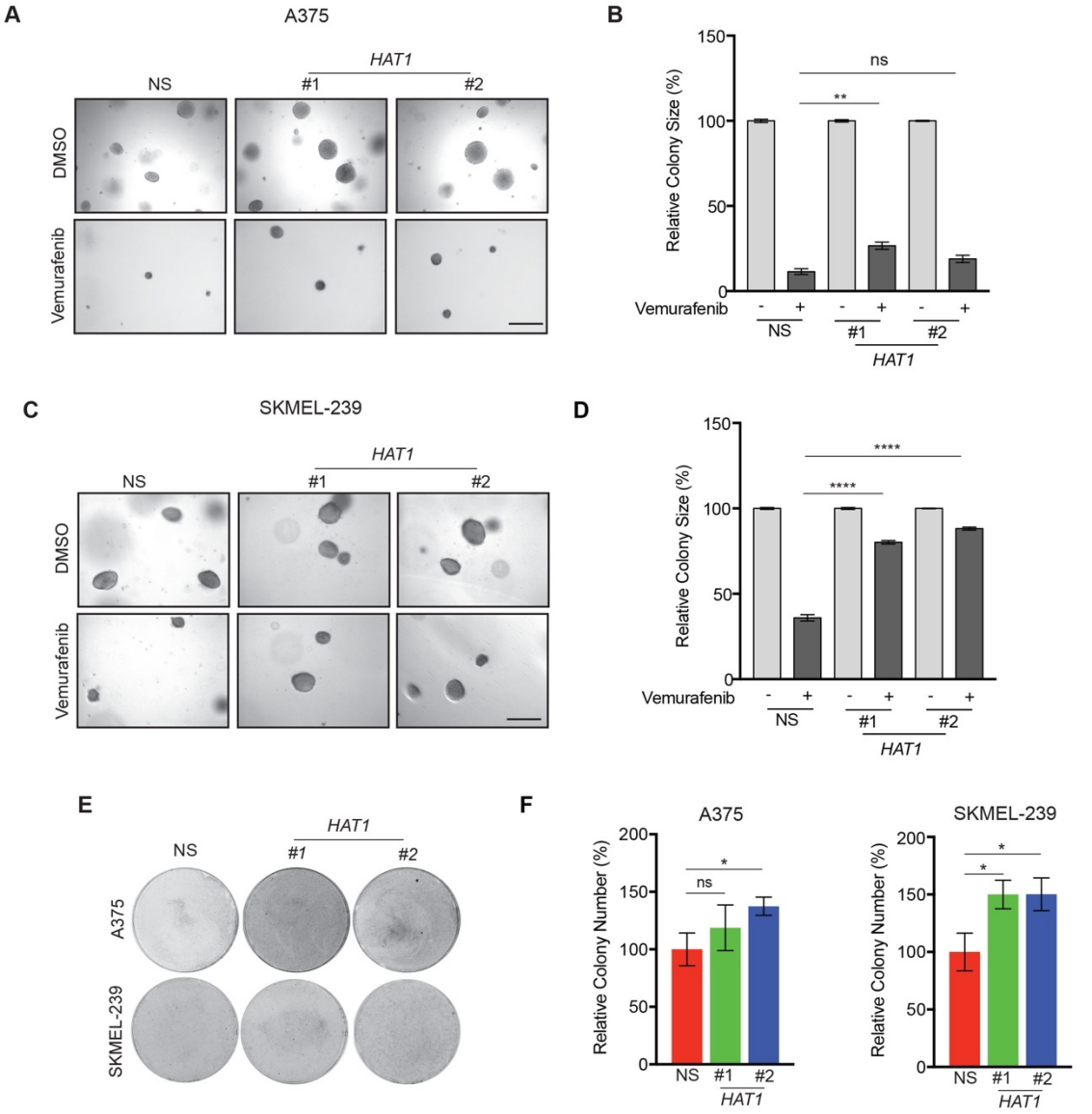

Fig. S2. *HAT1* knockdown confers vemurafenib resistance in BRAF-mutant melanoma cells. (A) A375 cells expressing non-specific (NS) or *HAT1* shRNAs were treated with vemurafenib (1 μM) or DMSO control, and anchorage-independent growth was measured by soft-agar assay. Representative images of soft-agar colonies under the indicated conditions are shown. Scale bar, 500 μM. (B) Relative colony size (%) for the data in panel A. (C) SKMEL-239 cells expressing NS or *HAT1* shRNAs were treated with vemurafenib (1 μM) or DMSO control, and anchorage-independent growth was measured by soft-agar assay. Representative images of soft-agar colonies under the indicated conditions are shown. Scale bar, 500 μM. (D) Relative colony size (%) for the data in panel C. (E) A375 and SKMEL-239 cells expressing NS or *HAT1* shRNAs were treated with vemurafenib (2 μM) and analysed by clonogenic assay. Representative clonogenic assay plates are shown. (F) Relative colony number (%) for the experiments

in panel E. Data are presented as the mean ± SEM. ns = not significant. *P<0.05,***P<0.001, and ****P<0.0001.

Fig. S3.

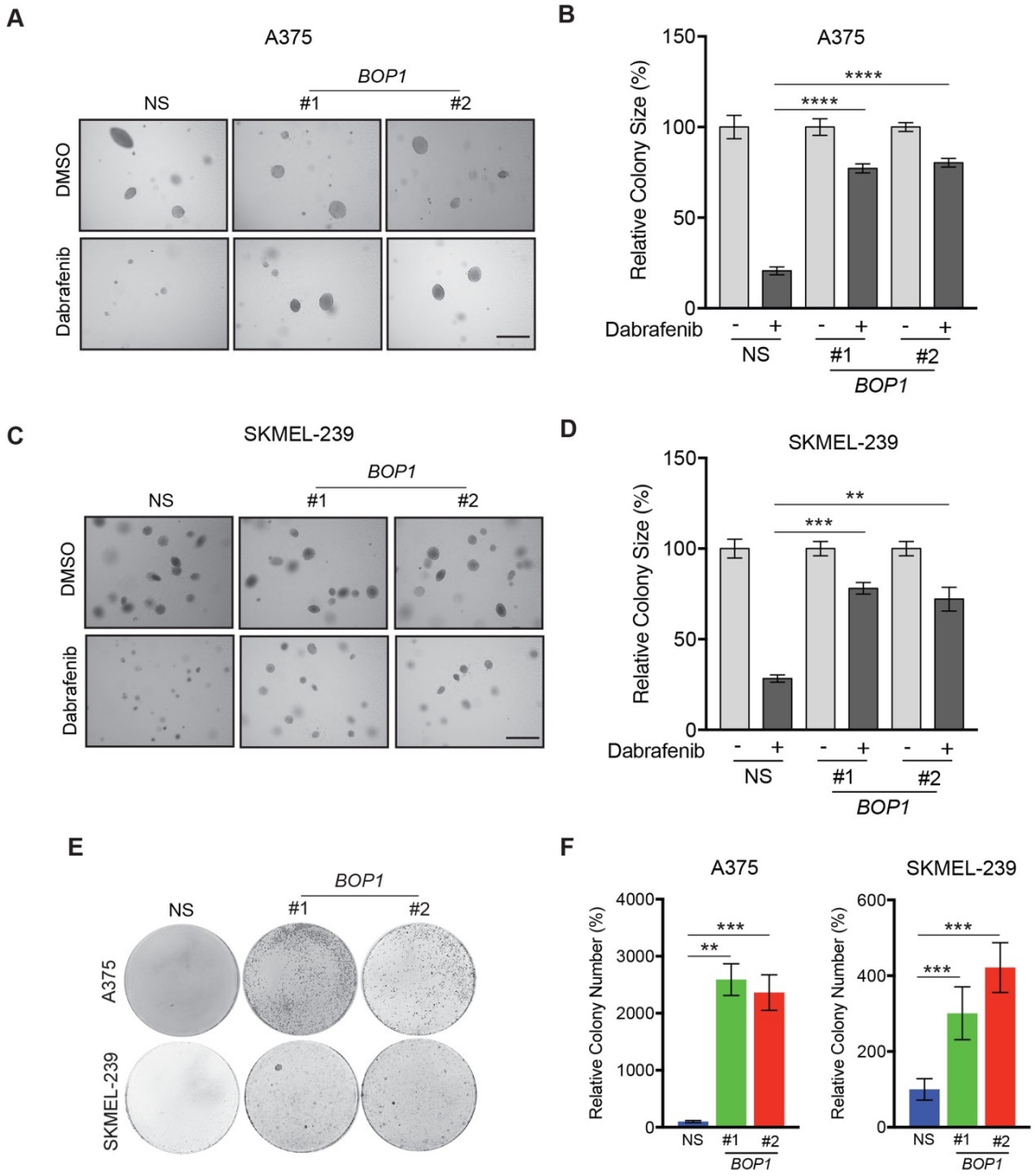

Fig. S3. Knockdown of *BOP1* confers resistance to the BRAFi, dabrafenib. (A) A375 cells expressing non-specific (NS) or *BOP1* shRNAs were treated with dabrafenib (50 nM) or DMSO control, and anchorage-independent growth was measured by soft-agar assay. Representative images of soft-agar colonies under the indicated conditions are shown. Scale bar, 500 μM. (B) Relative colony size (%) for the data in panel A. (C) SKMEL-239 cells expressing NS or *BOP1* shRNAs were treated with dabrafenib (50 nM) or DMSO control, and anchorage-independent growth was measured by soft-agar assay. Representative images of soft-agar colonies under the indicated conditions are shown. Scale bar, 500 μM. (D) Relative colony size (%) for the data in panel C. (E) A375 and SKMEL-239 cells expressing NS or *BOP1* shRNAs were treated with dabrafenib (100 nM) and analysed by clonogenic assay. Representative clonogenic assay plates are

shown. (F) Relative colony number (%) for the data in panel E. Data are presented as the mean ± SEM. **P<0.01, ***P<0.001, and ****P<0.0001.

Fig. S4.

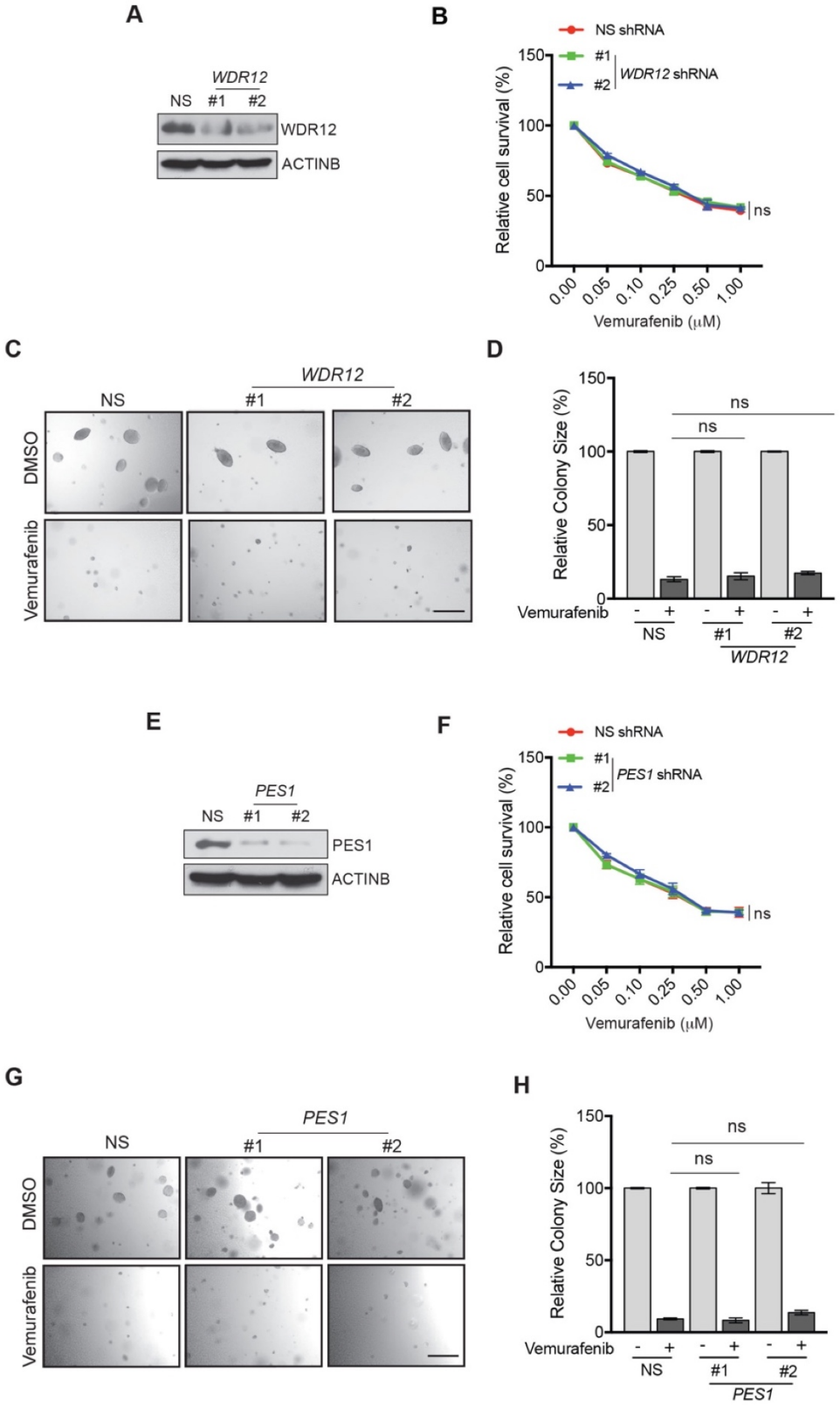
A
WDR12
NS #1 #2
WDR12
ACTINB
B
NS shRNA
#1
#2
WDR12 shRNA
Relative cell survival (%)
150
100
50
0
ns
0.00 0.05 0.10 0.25 0.50 1.00
Vemurafenib (μM)
C
WDR12
NS
#1
#2
DMSO
Vemurafenib
D
Relative Colony Size (%)
150
100
50
0
ns
ns
Vemurafenib - + - + - +
NS
#1
#2
WDR12
E
PES1
NS #1 #2
PES1
ACTINB
F
NS shRNA
#1
#2
PES1 shRNA
Relative cell survival (%)
150
100
50
0
ns
0.00 0.05 0.10 0.25 0.50 1.00
Vemurafenib (μM)
G
PES1
NS
#1
#2
DMSO
Vemurafenib
H
Relative Colony Size (%)
150
100
50
0
ns
ns
Vemurafenib - + - + - +
NS
#1
#2
PES1

Fig. S4. Knockdown of the PES1-BOP1-WDR12 complex proteins, WDR12 and PES1, does not confer resistance to BRAF inhibitors. (A) Levels of indicated proteins measured by immunoblotting in A375 cells expressing non-specific (NS) or *WDR12* shRNAs. (B) Relative cell survival (%) measured by MTT assay in A375 cells expressing NS or *WDR12* shRNAs and treated with indicated concentrations of vemurafenib or DMSO control for 3 days. (C) A375 cells expressing NS or *WDR12* shRNAs were treated with vemurafenib (1 μM) or DMSO control, and anchorage-independent growth was measured by soft-agar assay. Representative images of soft-agar colonies under the indicated conditions are shown. Scale bar, 500 μM. (D) Relative colony size (%) for the data in panel C. (E) Levels of indicated proteins measured by immunoblotting in A375 cells expressing NS or *PES1* shRNAs. (F) Relative cell survival (%) measured by MTT assay in A375 cells expressing NS or *PES1* shRNAs and treated with indicated concentrations of vemurafenib or DMSO control for 3 days. (G) A375 cells expressing NS or *PES1* shRNAs were treated with vemurafenib (1 μM) or DMSO control, and anchorage-independent growth was measured by soft-agar assay. Representative images of soft-agar colonies under the indicated conditions are shown. Scale bar, 500 μM. (H) Relative colony size (%) for the data in panel G. Data are presented as the mean ± SEM. ns = not significant.

Fig. S5. Type or paste caption here. Paste figure above the caption.

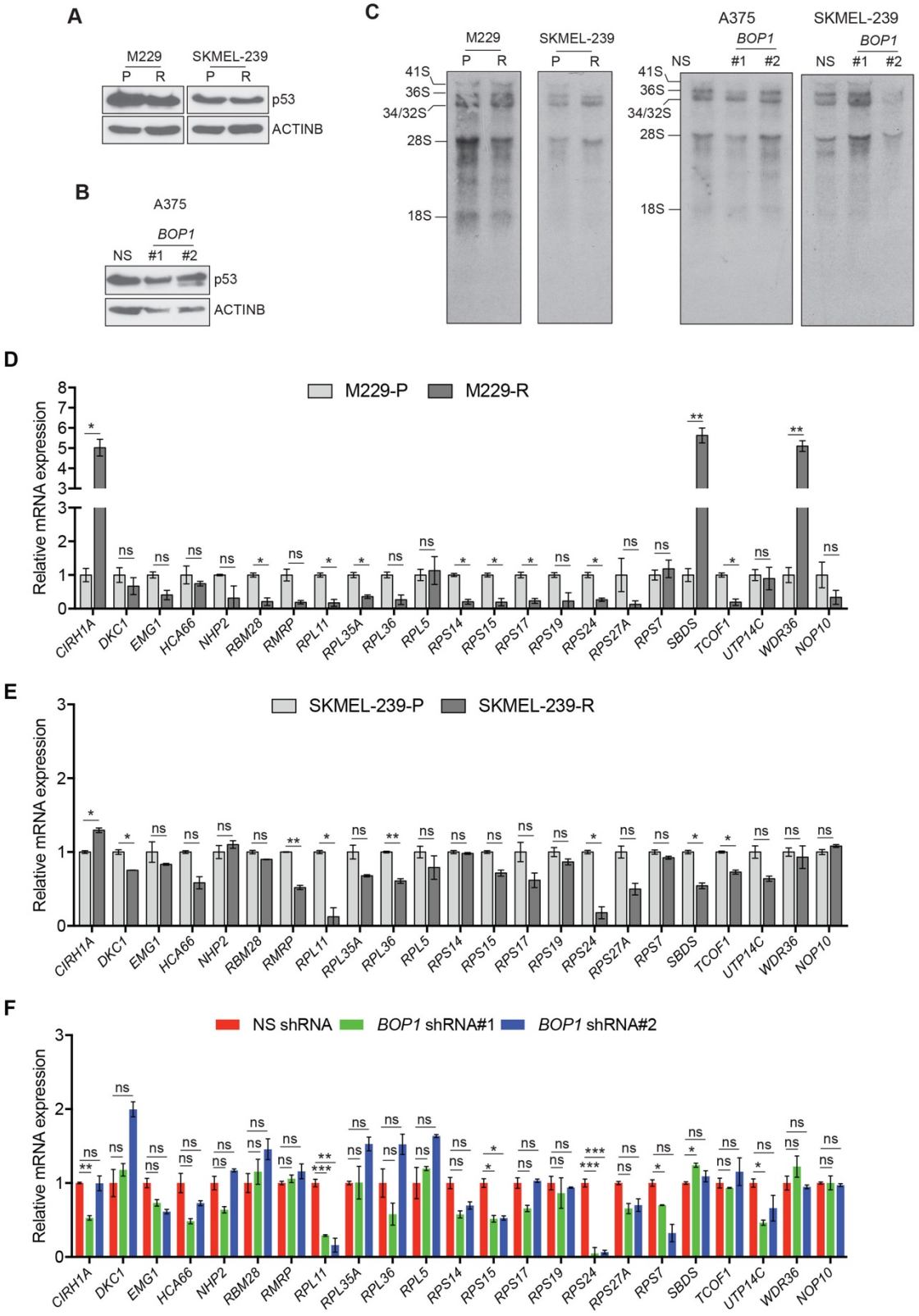

Fig. S5. Ribosomopathy does not drive BRAFi resistance. (A) Protein levels of p53 and ACTINB were measured by immunoblotting in the indicated BRAFi-sensitive parental (P) and BRAFi-resistant (R) cell lines. (B) Protein levels of p53 and ACTINB were measured by immunoblotting in A375 cells expressing non-specific (NS) or *BOP1* shRNAs. (C) Ribosomal RNA (rRNA) biogenesis in (Left) indicated BRAFi-sensitive parental (P) and resistant (R) cells and (Right) A375 cells expressing NS or *BOP1* shRNAs, as measured by tritiated uridine (H^3-U)-based metabolic labelling. (D) Expression of the indicated genes was measured in BRAFi-sensitive parental (P) and BRAFi-resistant (R) M229 cells by RT-qPCR; mRNA expression in R cells relative to P cells is shown. (E) Expression of the indicated genes was measured in BRAFi-sensitive parental (P) and BRAFi-resistant (R) SKMEL-239 cells by RT-qPCR; mRNA expression in R cells relative to P cells is shown. (F) Expression of the indicated genes was measured in A375 cells expressing NS or *BOP1* shRNAs by RT-qPCR; mRNA expression in shRNA-targeted cells relative to NS shRNA is shown. Data are presented as the mean ± SEM. ns = not significant, **P*<0.05, ***P*<0.01 and ****P*<0.001.

Fig. S6. Type or paste caption here. Paste figure above the caption.

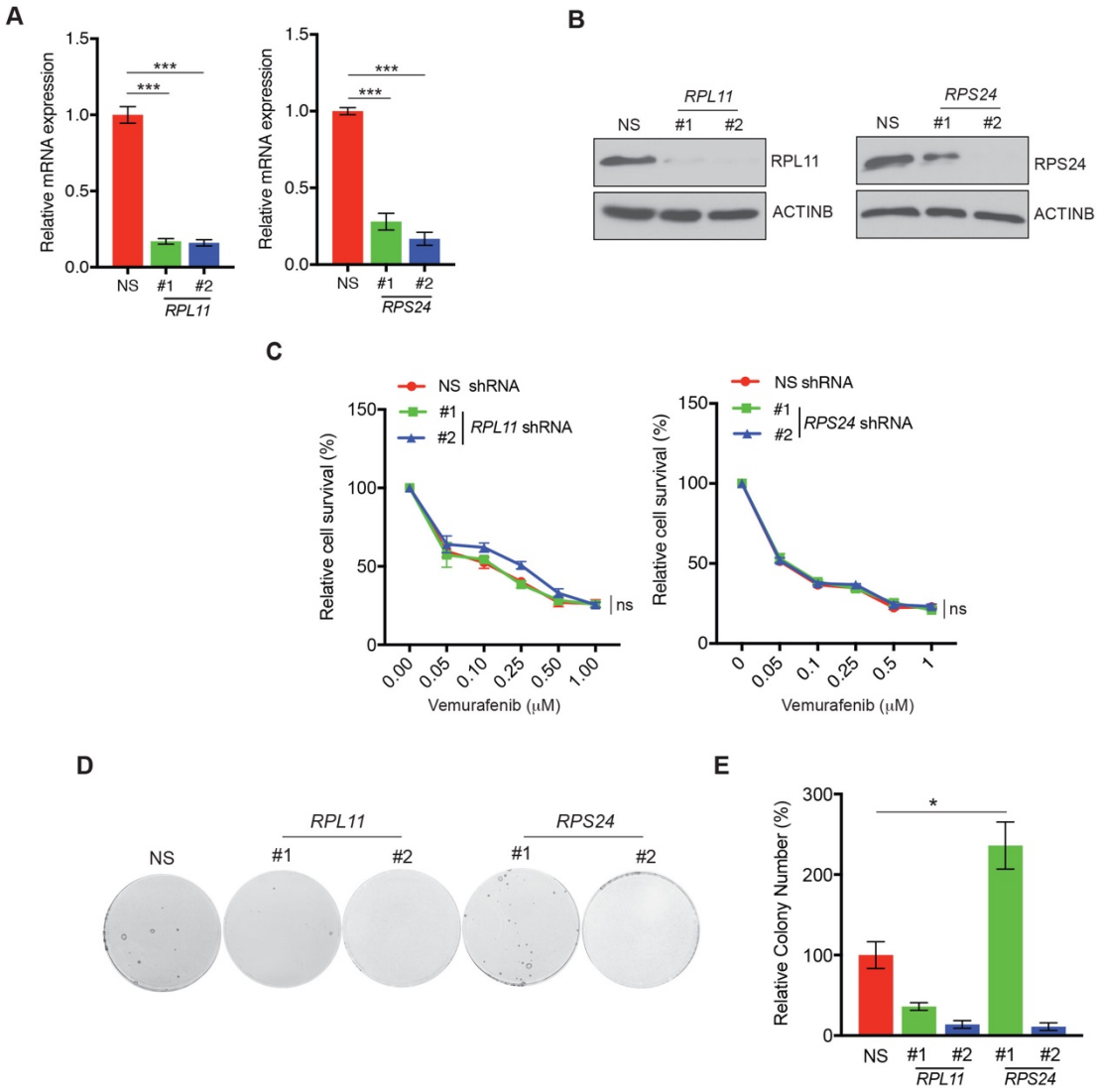

Fig. S6. Loss of ribosomopathy genes does not confer resistance to BRAF inhibitor. (A) Expression of *RPL11* and *RPS24* was measured by RT-qPCR in A375 cells containing non-specific (NS), *RPL11,* or *RPS24* shRNAs, as indicated; mRNA expression in shRNA-targeted cells relative to NS shRNA is shown. (B) Protein levels of RPL11 or RPS24 were measured by immunoblotting in A375 cells containing NS, *RPL11,* or *RPS24* shRNAs, as indicated. ACTINB was used as a loading control. (C) Relative cell survival (%) measured by MTT assay in A375 cells expressing NS, *RPL11,* or *RPS24* shRNAs that were treated with indicated concentrations of vemurafenib for 3 days. (D) A375 cells expressing NS, *RPL11,* or *RPS24* shRNAs were treated with vemurafenib (2 μM) or DMSO control and analysed by clonogenic assay. Representative clonogenic assay plates are shown. (E) Relative colony numbers (%) for the experiments in panel D. Data are presented as the mean ± SEM. ns = not significant. **P*<0.05 and ****P*<0.001.

Fig. S7.

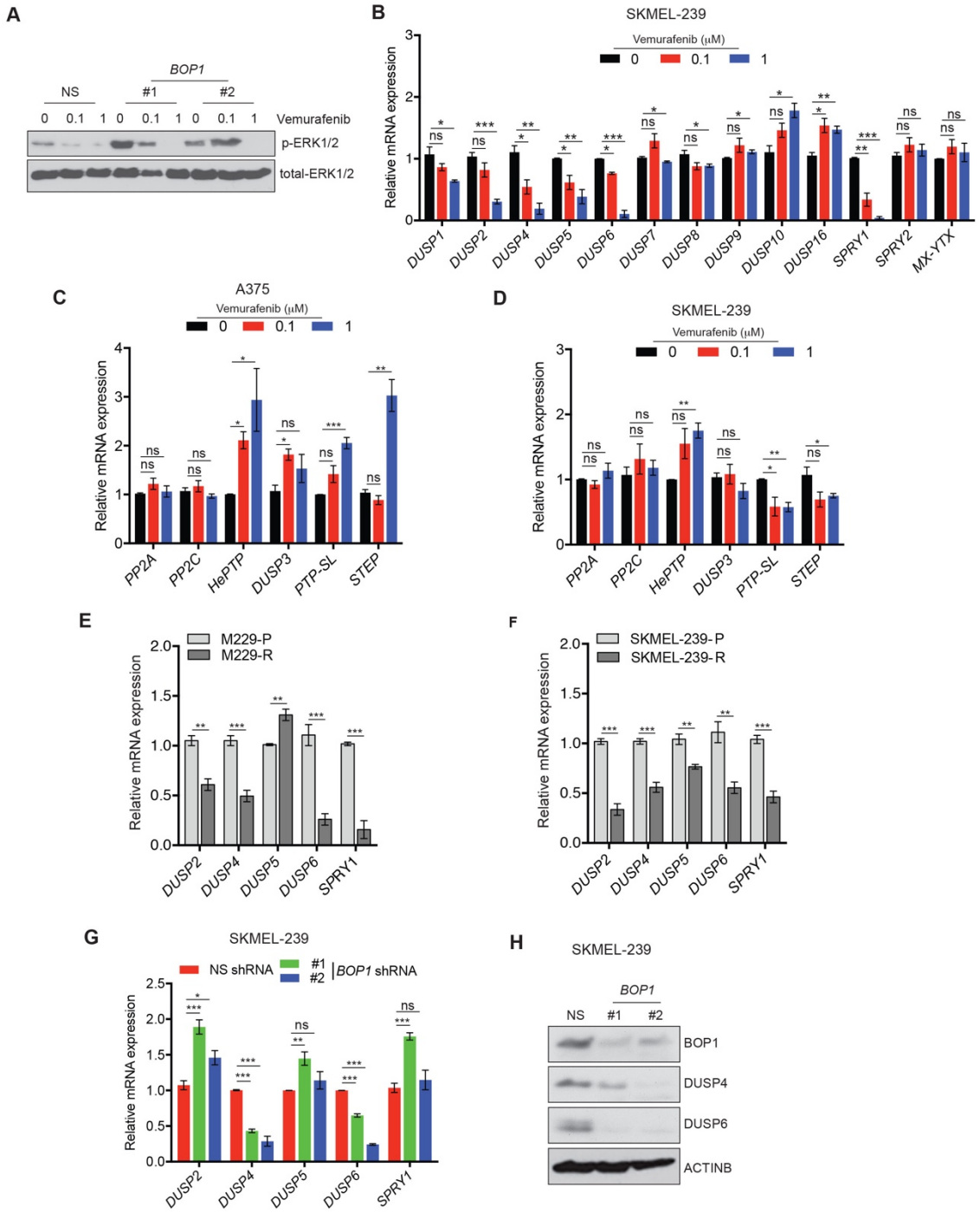

Fig. S7. Loss of BOP1 enhances the MAP kinase pathway by regulating *DUSP4* and *DUSP6*. (A) Levels of indicated proteins were measured by immunoblotting in SKMEL-239 cells expressing non-specific (NS) or *BOP1* shRNAs and treated with indicated concentrations of vemurafenib (0.1 or 1.0 μM) or DMSO for 3 h. (B) Levels of indicated phosphatases were measured by RT-qPCR in SKMEL-239 cells treated with vemurafenib (0.1 or 1 μM) or DMSO control for 24 h. Relative mRNA expression of indicated phosphatases in vemurafenib-treated relative to DMSO-treated cells is shown. (C) Levels

of indicated phosphatases were measured by RT-qPCR in A375 cells treated with vemurafenib (0.1 or 1 μM) or DMSO control for 24 h. Relative mRNA expression of indicated phosphatases in vemurafenib-treated relative to DMSO-treated cells is shown. (D) Levels of indicated phosphatases were measured by RT-qPCR in SKMEL-239 cells treated with vemurafenib (0.1 or 1 μM) or DMSO control for 24 h. Relative mRNA expression of indicated phosphatases in vemurafenib-treated relative to DMSO-treated cells is shown. (E) Levels of indicated phosphatases were measured by RT-qPCR in M229 parent (P) or BRAFi-resistant M229 (M229-R) cells. Relative mRNA expression of indicated phosphatases in M229-R relative to P cells is shown. (F) Levels of indicated phosphatases were measured by RT-qPCR in SKMEL-239 parent (P) or BRAFi-resistant SKMEL-239 (SKMEL-239-R) cells. Relative mRNA expression of indicated phosphatases in SKMEL-239-R relative to P cells is shown. (G) Levels of indicated phosphatases were measured by RT-qPCR in SKMEL-239 cells expressing NS or *BOP1* shRNAs. Relative mRNA expression in shRNA-targeted cells relative to NS shRNA is shown. (H) Levels of indicated proteins were measured by immunoblotting in SKMEL-239 cells expressing NS or *BOP1* shRNAs. Data are presented as the mean ± SEM. ns = not significant. **P*<0.05, ***P*<0.01, and ****P*<0.001.

Fig. S8.

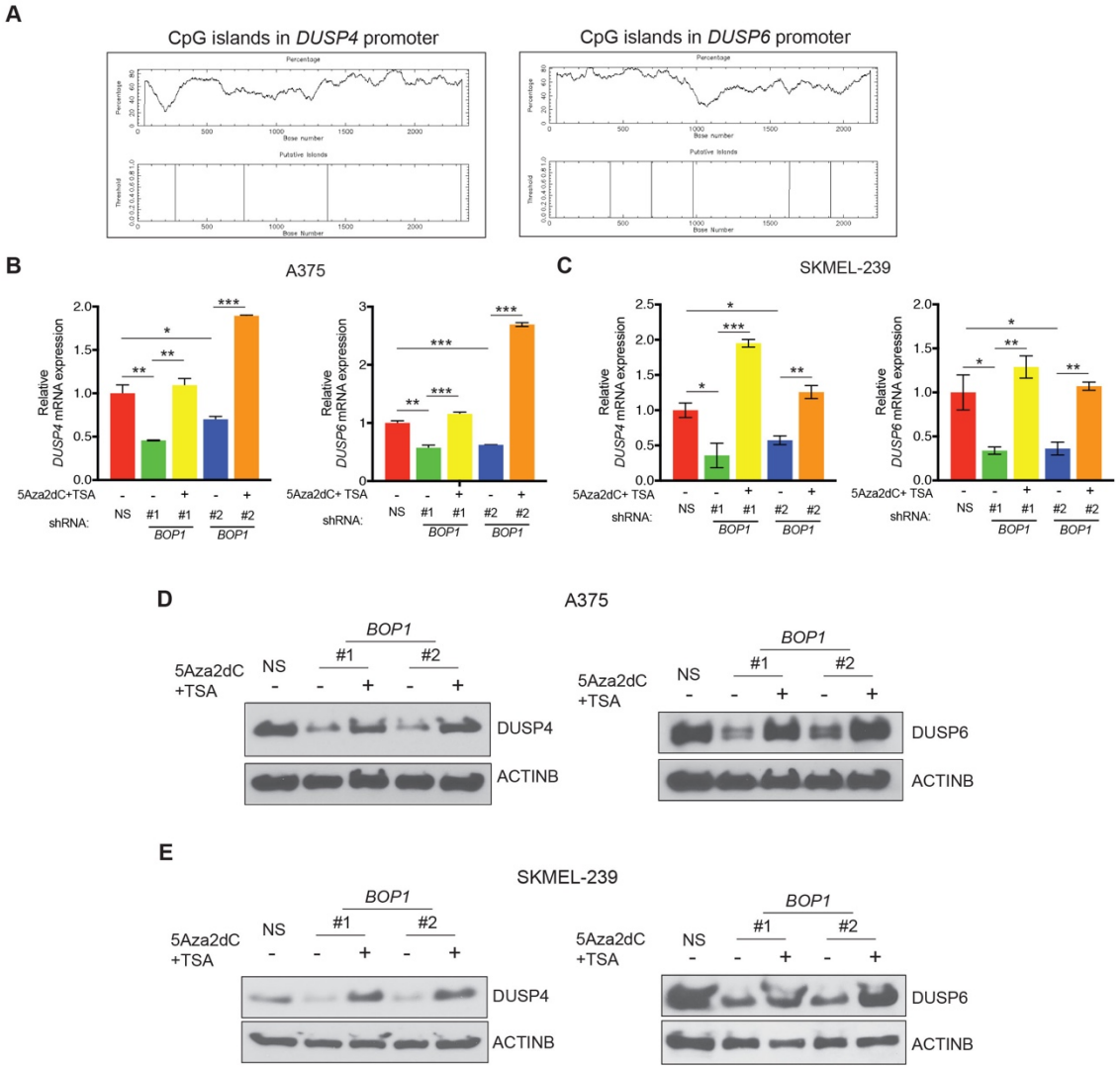

Fig. S8. BOP1 loss results in transcriptional silencing of *DUSP4* and *DUSP6*. (A) The European Bioinformatic Instititue (EBI) CpG plot analysis of the promoter sequences for *DUSP4* and *DUSP6* reveal the presence of CpG islands. (B) Expression of *DUSP4* and *DUSP6* was measured by RT-qPCR in A375 cells containing non-specific (NS) or *BOP1* shRNAs, treated with 5Aza2dC (5 μM; 72 h) and TSA (1 μM; 12 h). Relative mRNA expression in shRNA-targeted cells relative to NS shRNA is shown. (C) Expression of *DUSP4* and *DUSP6* was measured by RT-qPCR in SKMEL-239 cells expressing NS or *BOP1* shRNAs, treated with 5Aza2dC (5 μM; 72 h) and TSA (1 μM; 12 h). Relative mRNA expression in shRNA-targeted cells relative to NS shRNA is shown. (D) Levels of DUSP4 and DUSP6 proteins were measured by immunoblotting in A375 cells expressing NS or *BOP1* shRNAs, treated with 5Aza2dC (5 μM, 72 h) and TSA (1 μM, 12 h). ACTINB was used as a loading control. (E) Levels of DUSP4 and DUSP6 proteins were measured by immunoblotting in SKMEL-239 cells expressing NS or *BOP1* shRNAs, treated with 5Aza2dC (5 μM, 72 h) and TSA (1 μM, 12 h). ACTINB was used

as a loading control. Data are presented as the mean ± SEM. *P<0.05, **P<0.01, and ***P<0.001.

Table S1. List of genes targeted by the human epigenome-wide shRNA library and shRNA IDs.

S.No.	Gene Name	shRNA IDs
1	2410016O06Rik	TRCN0000180487
2	ACTL6A	TRCN0000072273 TRCN0000072274 TRCN0000072275 TRCN0000072277 TRCN0000072276
3	ACTL6B	TRCN0000116767 TRCN0000116768 TRCN0000116769 TRCN0000116770 TRCN0000116771
4	AIRE	TRCN0000018890 TRCN0000018891 TRCN0000018892 TRCN0000018893 TRCN0000018894
5	ALKBH2	TRCN0000064678 TRCN0000064679 TRCN0000064680 TRCN0000064681 TRCN0000064682
6	AOF1/KDM1B	TRCN0000046073 TRCN0000046074 TRCN0000046076 TRCN0000046075 TRCN0000046077
7	AOF2	TRCN0000046068 TRCN0000046069 TRCN0000046070 TRCN0000046071 TRCN0000046072
8	APITD1	TRCN0000038878 TRCN0000038874 TRCN0000191787

9	ARID1A	TRCN0000059089 TRCN0000059090 TRCN0000059092 TRCN0000059088 TRCN0000059091 TRCN0000071394 TRCN0000071397
10	ARID3C	TRCN0000201971
11	ARID4A	TRCN0000014595 TRCN0000014593 TRCN0000014594 TRCN0000014596 TRCN0000014597
12	ASF1A	TRCN0000074268 TRCN0000074269 TRCN0000074271 TRCN0000074272 TRCN0000074270
13	ASF1B	TRCN0000074225 TRCN0000074226 TRCN0000074227 TRCN0000108962
14	ASH1L	TRCN0000016168 TRCN0000016169 TRCN0000016170 TRCN0000016171 TRCN0000016172
15	ASH2L	TRCN0000019274 TRCN0000019275 TRCN0000019276 TRCN0000019277 TRCN0000019278
16	ASXL1	TRCN0000135296 TRCN0000138572 TRCN0000133699 TRCN0000134690 TRCN0000135579
17	ATM	TRCN0000010299 TRCN0000038654 TRCN0000039948

18	ATR	TRCN0000039614 TRCN0000007749 TRCN0000023912 TRCN0000023913
19	ATRX	TRCN0000013588 TRCN0000013589 TRCN0000013590 TRCN0000013591 TRCN0000013592
20	AURKB	TRCN0000000776 TRCN0000010547 TRCN0000000777 TRCN0000000778 TRCN0000000779
21	BAZ1A	TRCN0000034279 TRCN0000034280 TRCN0000034281 TRCN0000034282 TRCN0000034283
22	BAZ1B	TRCN0000013339 TRCN0000013342 TRCN0000013340 TRCN0000013341 TRCN0000013338 TRCN0000108939
23	BAZ2A	TRCN0000015568 TRCN0000015569 TRCN0000015571 TRCN0000015572 TRCN0000015570
24	BAZ2B	TRCN0000019928 TRCN0000019924 TRCN0000019926 TRCN0000019925 TRCN0000019927 TRCN0000116909 TRCN0000116910 TRCN0000116908 TRCN0000200866 TRCN0000191572

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26	BMI1	TRCN0000020154 TRCN0000020155 TRCN0000020156 TRCN0000020157 TRCN0000020158
27	BOP1	TRCN0000078068 TRCN0000078069 TRCN0000078070 TRCN0000078071 TRCN0000078072
28	BPTF	TRCN0000016818 TRCN0000016819 TRCN0000016820 TRCN0000016821 TRCN0000016822
29	BRAF	TRCN0000006289 TRCN0000006290 TRCN0000006291 TRCN0000006292 TRCN0000006293
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31	BRD2	TRCN0000006308 TRCN0000006309 TRCN0000006310 TRCN0000006311 TRCN0000006312
32	BRD3	TRCN0000021374 TRCN0000021375 TRCN0000021376 TRCN0000021377

		TRCN0000021378
33	BRD4	TRCN0000021424 TRCN0000021425 TRCN0000021426 TRCN0000021427 TRCN0000021428
34	BRD7	TRCN0000151378 TRCN0000151543 TRCN0000154102
35	BRD8	TRCN0000019379 TRCN0000019380 TRCN0000019381 TRCN0000019382 TRCN0000019383 TRCN0000096646
36	BRD9	TRCN0000127634 TRCN0000127780 TRCN0000128333 TRCN0000128610 TRCN0000131081
37	BRDT	TRCN0000006303 TRCN0000006304 TRCN0000006305 TRCN0000006306 TRCN0000006307
38	BRPF1	TRCN0000021909 TRCN0000021912 TRCN0000021913 TRCN0000019287 TRCN0000021910 TRCN0000019286 TRCN0000019288 TRCN0000019285 TRCN0000019284
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40	BRWD1	TRCN0000062663

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41	BRWD3	TRCN0000160865 TRCN0000159352 TRCN0000159686 TRCN0000136866 TRCN0000162485
42	BTAF1	TRCN0000013345 TRCN0000013347 TRCN0000013343 TRCN0000013346 TRCN0000013344
43	C1ORF149/MEAF6	TRCN0000130900 TRCN0000131146 TRCN0000131218 TRCN0000127694 TRCN0000128122
44	C20orf20/MRGBP	TRCN0000158734 TRCN0000159338 TRCN0000159786 TRCN0000159916 TRCN0000159917
45	CARM1	TRCN0000007167 TRCN0000011071 TRCN0000007168 TRCN0000007169
46	CBX1	TRCN0000062223 TRCN0000062224 TRCN0000062225 TRCN0000062227
47	CBX2	TRCN0000020324 TRCN0000020325 TRCN0000020326 TRCN0000020327 TRCN0000020328
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		TRCN0000021916 TRCN0000021917 TRCN0000021918
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75	CXXC1	TRCN0000155700 TRCN0000155371 TRCN0000152721 TRCN0000155409 TRCN0000156075
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103	GCN5L2/KAT2A	TRCN0000038879 TRCN0000038880 TRCN0000038881 TRCN0000038882 TRCN0000038883
104	GON4L	TRCN0000133702 TRCN0000134438 TRCN0000133891
105	GTF3C4	TRCN0000013398 TRCN0000013399 TRCN0000013400 TRCN0000013401 TRCN0000013402
106	H2AFB1	TRCN0000106825 TRCN0000106827 TRCN0000106829 TRCN0000106895 TRCN0000106896 TRCN0000106898 TRCN0000106899 TRCN0000106826 TRCN0000106828 TRCN0000106897
107	H2AFJ	TRCN0000106746

		TRCN0000106749 RCN0000106745 TRCN0000106747 TRCN0000106748
108	H2AFV	TRCN0000106835 TRCN0000106837 TRCN0000106838 TRCN0000106839 TRCN0000106836 TRCN0000073848
109	H2AFY	TRCN0000106691 TRCN0000106694 TRCN0000106690 TRCN0000106692 TRCN0000106693 TRCN0000097039
110	H2AFY3	TRCN0000096926
111	H2AFZ	TRCN0000072583 TRCN0000072584 TRCN0000072585 TRCN0000072586 TRCN0000072587
112	H2BFM	TRCN0000015523 TRCN0000015524 TRCN0000015526 TRCN0000015527 TRCN0000139134 TRCN0000141476 TRCN0000015525
113	HAT1	TRCN0000034734 TRCN0000034735 TRCN0000034736 TRCN0000034737 TRCN0000034738
114	HCFC1	TRCN0000016263 TRCN0000016264 TRCN0000016265 TRCN0000016266 TRCN0000016267
115	HDAC1	TRCN0000004814

		TRCN0000004815 TRCN0000004816 TRCN0000004817 TRCN0000004818
116	HDAC10	TRCN0000004859 TRCN0000004860 TRCN0000004861 TRCN0000004862 TRCN0000004863
117	HDAC11	TRCN0000017753 TRCN0000017754 TRCN0000017755 TRCN0000017756 TRCN0000017757
118	HDAC2	TRCN0000004819 TRCN0000004820 TRCN0000004821 TRCN0000004822 TRCN0000004823
119	HDAC3	TRCN0000004824 TRCN0000004825 TRCN0000004826 TRCN0000004827 TRCN0000004828
120	HDAC4	TRCN0000004829 TRCN0000004830 TRCN0000004831 TRCN0000004832 TRCN0000004833
121	HDAC5	TRCN0000004834 TRCN0000004835 TRCN0000004836 TRCN0000004837 TRCN0000004838
122	HDAC6	TRCN0000004839 TRCN0000004840 TRCN0000004841 TRCN0000004842 TRCN0000004843
123	HDAC7	TRCN0000004844

		TRCN0000004845 TRCN0000004846 TRCN0000004847 TRCN0000004848
124	HDAC8	TRCN0000004849 TRCN0000004850 TRCN0000004851 TRCN0000004852 TRCN0000004853
125	HDAC9	TRCN0000004854 TRCN0000004855 TRCN0000004856 TRCN0000004857 TRCN0000004858
126	HELLS	TRCN0000000306 TRCN0000000307 TRCN0000000308 TRCN0000000309 TRCN0000000310
127	HILS1	TRCN0000106970 TRCN0000106971 TRCN0000106972 TRCN0000106973 TRCN0000106974
128	HIRA	TRCN0000020516 TRCN0000020515 TRCN0000020514 TRCN0000020515 TRCN0000020516 TRCN0000020517 TRCN0000020518
129	HLTF	TRCN0000003971 TRCN0000003972 TRCN0000003973 TRCN0000010836 TRCN0000003974
130	HMG20B	TRCN0000015500 TRCN0000015499 TRCN0000015498 TRCN0000015501

131	HMGA1	TRCN0000004909 TRCN0000018953 TRCN0000018950 TRCN0000018951 TRCN0000018949 TRCN0000018952
132	HMGA2	TRCN0000021964 TRCN0000021967 TRCN0000021968 TRCN0000021965 TRCN0000126047 TRCN0000021966
133	HMGB1	TRCN0000018930 TRCN0000018932 TRCN0000018934 TRCN0000092693 TRCN0000018933 TRCN0000063714 TRCN0000018931
134	HMGB2	TRCN0000019009 TRCN0000019010 TRCN0000019013 TRCN0000019012 TRCN0000019011 TRCN0000092929 TRCN0000092932 TRCN0000092942
135	HMGB3	TRCN0000018518 TRCN0000018519 TRCN0000018520 TRCN0000071432 TRCN0000016705
136	HMGN1	TRCN0000019059 TRCN0000019060 TRCN0000019061 TRCN0000019062 TRCN0000019063
137	HMGN2	TRCN0000018551 TRCN0000018549 TRCN0000127823

		TRCN0000018552 TRCN0000108988 TRCN0000130247 TRCN0000018548 TRCN0000018550
138	HMGN3	TRCN0000019105 TRCN0000019104 TRCN0000019108 TRCN0000019106 TRCN0000019107
139	HTATIP/KAT5	TRCN0000020314 TRCN0000020315 TRCN0000020316 TRCN0000020317 TRCN0000020318
140	ING1	TRCN0000073268 TRCN0000073269 TRCN0000073270 TRCN0000073271 TRCN0000073272
141	ING2	TRCN0000019214 TRCN0000019215 TRCN0000019216 TRCN0000019217 TRCN0000019218
142	ING3	TRCN0000073273 TRCN0000073277 TRCN0000073274 TRCN0000073275 TRCN0000073276
143	ING4	TRCN0000128673 TRCN0000129127 TRCN0000129334 TRCN0000129395 TRCN0000131049 TRCN0000103947
144	ING5	TRCN0000020089 TRCN0000020091 TRCN0000020090 TRCN0000020092

		TRCN0000020093
145	INOC1	TRCN0000107555 TRCN0000107556 TRCN0000107557 TRCN0000107558 TRCN0000107559
146	JARID1A	TRCN0000014628 TRCN0000014629 TRCN0000014630 TRCN0000014631 TRCN0000014632
147	JARID1B	TRCN0000014758 TRCN0000014759 TRCN0000014760 TRCN0000014761 TRCN0000014762
148	JARID1C	TRCN0000022084 TRCN0000022085 TRCN0000022084 TRCN0000022085 TRCN0000022087 TRCN0000022088
149	JARID1D	TRCN0000022114 TRCN0000022115 TRCN0000022116 TRCN0000022117 TRCN0000022118
150	JARID2	TRCN0000107365 TRCN0000107366 TRCN0000107367 TRCN0000107368 TRCN0000107369
151	JMJD1A	TRCN0000021149 TRCN0000021150 TRCN0000021151 TRCN0000021152 TRCN0000021153
152	JMJD1B	TRCN0000017093 TRCN0000017094 TRCN0000017095

		TRCN0000017096 TRCN0000017097
153	JMJD1C	TRCN0000107560 TRCN0000107561 TRCN0000107562 TRCN0000107563 TRCN0000107564
154	JMJD2A	TRCN0000013493 TRCN0000013494 TRCN0000013495 TRCN0000013496 TRCN0000013497
155	JMJD2B	TRCN0000018013 TRCN0000018014 TRCN0000018015 TRCN0000018016 TRCN0000018017
156	JMJD2C	TRCN0000022054 TRCN0000022055 TRCN0000022056 TRCN0000022057 TRCN0000022058
157	JMJD2D	TRCN0000149641 TRCN0000149414 TRCN0000147186 TRCN0000148837 TRCN0000148192
158	JMJD3/KDM6B	TRCN0000095268
159	JMJD4	TRCN0000138244 TRCN0000138555 TRCN0000138689 TRCN0000137919 TRCN0000138740
160	JMJD5	TRCN0000129536 TRCN0000128906 TRCN0000130971 TRCN0000130438 TRCN0000130552
161	JMJD6	TRCN0000063338 TRCN0000063339

		TRCN0000063340 TRCN0000063341 TRCN0000063342
162	L3MBTL	TRCN0000016863 TRCN0000016864 TRCN0000016865 TRCN0000016866 TRCN0000016867
163	L3MBTL2	TRCN0000021725 TRCN0000021728 TRCN0000021726 TRCN0000021727 TRCN0000021724
164	MBD1	TRCN0000015428 TRCN0000015429 TRCN0000015430 TRCN0000015431 TRCN0000015432
165	MBD2	TRCN0000013318 TRCN0000013319 TRCN0000013320 TRCN0000013321 TRCN0000013322
166	MBD3	TRCN0000017353 TRCN0000017354 TRCN0000017355 TRCN0000017356 TRCN0000017357
167	MBD4	TRCN0000013313 TRCN0000013314 TRCN0000013315 TRCN0000013316 TRCN0000013317
168	MBTD1	TRCN0000153466 TRCN0000152974 TRCN0000151070 TRCN0000150313 TRCN0000154234 TRCN0000078113 TRCN0000073848

		TRCN0000097657 TRCN0000097655
169	MDC1	TRCN0000018850 TRCN0000018851 TRCN0000018852 TRCN0000018853 TRCN0000018854
170	MDS1	TRCN0000015583 TRCN0000015584 TRCN0000015585 TRCN0000015586 TRCN0000015587
171	MECP2	TRCN0000021239 TRCN0000021240 TRCN0000021241 TRCN0000021242 TRCN0000021243
172	MEN1	TRCN0000040138 TRCN0000040139 TRCN0000040140 TRCN0000040141 TRCN0000040142
173	METTL8	TRCN0000007228
174	MGMT	TRCN0000022364 TRCN0000022365 TRCN0000022366 TRCN0000022367 TRCN0000022368
175	MIER1	TRCN0000108032 TRCN0000108030 TRCN0000108031 TRCN0000108033 TRCN0000108034 TRCN0000095734 TRCN0000095737
176	MIER2	TRCN0000137269 TRCN0000138895 TRCN0000138939 TRCN0000137227 TRCN0000137705

177	MIER3	TRCN0000127638 TRCN0000130779 TRCN0000129622 TRCN0000128394 TRCN0000129860
178	MLL1	TRCN0000108069
179	MLL3	TRCN0000008742 TRCN0000008743 TRCN0000008744 TRCN0000008745 TRCN0000008746 TRCN0000008746
180	MLL4	TRCN0000005958 TRCN0000005959 TRCN0000005960 TRCN0000005961 TRCN0000005962
181	MLL4/WBP7	TRCN0000005958 TRCN0000005959 TRCN0000005960 TRCN0000005961 TRCN0000005962
182	MLL5	TRCN0000150550 TRCN0000154711 TRCN0000155824 TRCN0000157609 TRCN0000158279
183	MLLT6	TRCN0000019902 TRCN0000019899 TRCN0000019901 TRCN0000019903 TRCN0000019900 TRCN0000074123
184	MORF4L1	TRCN0000107580 TRCN0000107581 TRCN0000107582 TRCN0000107583 TRCN0000107584 TRCN0000015007
185	MORF4L2	TRCN0000107309

		TRCN0000107307 TRCN0000107305 TRCN0000107306 TRCN0000107308 TRCN0000095666
186	MPHOSPH8	TRCN0000117922 TRCN0000117925 TRCN0000117923 TRCN0000117926 TRCN0000117924 TRCN0000085440
187	MSL3L1/MSL3	TRCN0000022104 TRCN0000022105 TRCN0000022106 TRCN0000022107 TRCN0000022108
188	MTA1	TRCN0000013358 TRCN0000013359 TRCN0000013360 TRCN0000013361 TRCN0000013362
189	MTA2	TRCN0000013373 TRCN0000013374 TRCN0000013375 TRCN0000013376 TRCN0000013377
190	MTA3	TRCN0000016458 TRCN0000016459 TRCN0000016460 TRCN0000016461 TRCN0000016462
191	MTF2	TRCN0000107680 TRCN0000107681 TRCN0000107682 TRCN0000107683 TRCN0000107684 TRCN0000086133 TRCN0000086137
192	MYST1	TRCN0000034875 TRCN0000034876

		TRCN0000034877 TRCN0000034878
193	MYST2	TRCN0000021629 TRCN0000021630 TRCN0000021631 TRCN0000021632 TRCN0000021633
194	MYST3	TRCN0000013123 TRCN0000013124 TRCN0000013125 TRCN0000013126
195	MYST4	TRCN0000019359 TRCN0000019360 TRCN0000019361 TRCN0000019362 TRCN0000019363
196	N6AMT1	TRCN0000038755 TRCN0000038758 TRCN0000038754 TRCN0000038757 TRCN0000038756
197	N6AMT2	TRCN0000139966 TRCN0000122732 TRCN0000140564 TRCN0000122562 TRCN0000145142
198	NAP1I1	TRCN0000149610 TRCN0000149872 TRCN0000148741 TRCN0000149921 TRCN0000155836 TRCN0000092890
199	NAP1L2	TRCN0000147762 TRCN0000146531 TRCN0000146873 TRCN0000148173 TRCN0000147038
200	NAP1L3	TRCN0000149156 TRCN0000147100 TRCN0000149498

		TRCN0000147275 TRCN0000149864
201	NAP1L4	TRCN0000151475 TRCN0000154499 TRCN0000155016 TRCN0000151026 TRCN0000156041
202	NCOA1	TRCN0000004082 TRCN0000004080 TRCN0000004078 TRCN0000004079 TRCN0000095569 TRCN0000004081
203	NCOA3	TRCN0000019699 TRCN0000019700 TRCN0000019701 TRCN0000019702 TRCN0000019703
204	NCOA6	TRCN0000063267 TRCN0000063264 TRCN0000063266 TRCN0000063263 TRCN0000063265 TRCN0000176319
205	NCOR1	TRCN0000060654 TRCN0000060657 TRCN0000060656 TRCN0000060653 TRCN0000060655
206	NCOR2	TRCN0000060704 TRCN0000060706 TRCN0000060703 TRCN0000060707 TRCN0000060705 TRCN0000063970 TRCN0000095279
207	NR0B2	TRCN0000033649 TRCN0000033650 TRCN0000033651 TRCN0000033652

		TRCN0000033653
208	NSD1	TRCN0000061353 TRCN0000061354 TRCN0000061356 TRCN0000061357
209	PADI4	TRCN0000051678 TRCN0000051679 TRCN0000051680 TRCN0000051681
210	PARP1	TRCN0000007928 TRCN0000007929 TRCN0000007930 TRCN0000007931 TRCN0000007932
211	PARP2	TRCN0000007933 TRCN0000007934 TRCN0000007935 TRCN0000007936 TRCN0000007937
212	PAX5	TRCN0000016058 TRCN0000016059 TRCN0000016060 TRCN0000016061 TRCN0000016062
213	PAXIP1	TRCN0000128479 TRCN0000150101 TRCN0000147957 TRCN0000147635 TRCN0000129174
214	PBRM1	TRCN0000015995 TRCN0000015994 TRCN0000015993 TRCN0000015997 TRCN0000007228
215	PCAF/KAT2B	TRCN0000018528 TRCN0000018529 TRCN0000018530 TRCN0000018531 TRCN0000018532
216	PCGF1	TRCN0000073131

		TRCN0000073128 TRCN0000073129 TRCN0000073130 TRCN0000073132
217	PCGF2	TRCN0000022029 TRCN0000022030 TRCN0000022031 TRCN0000022032 TRCN0000022033
218	PCGF3	TRCN0000095494
219	PCGF5	TRCN0000073113 TRCN0000073115 TRCN0000073117 TRCN0000073116 TRCN0000140719 TRCN0000095162 TRCN0000073114
220	PCGF6	TRCN0000073108 TRCN0000073109 TRCN0000073112 TRCN0000073110 TRCN0000073111 TRCN0000095301
221	PCMT1	TRCN0000036399 TRCN0000036400 TRCN0000036401 TRCN0000036402 TRCN0000036403
222	PCNA	TRCN0000003861 TRCN0000003862 TRCN0000003863 TRCN0000003864 TRCN0000010826
223	PHF1	TRCN0000019184 TRCN0000019185 TRCN0000019186 TRCN0000019187 TRCN0000019188
224	PHF11	TRCN0000020112 TRCN0000020110

		TRCN0000020111 TRCN0000020113 TRCN0000020109 TRCN0000073848
225	PHF12	TRCN0000015705 TRCN0000015706 TRCN0000015707 TRCN0000015704 TRCN0000015703 TRCN0000007228 TRCN0000084422 TRCN0000084419
226	PHF13	TRCN0000019637 TRCN0000019635 TRCN0000019634 TRCN0000019636 TRCN0000019638
227	PHF14	TRCN0000019310 TRCN0000019309 TRCN0000019311 TRCN0000019312 TRCN0000019313
228	PHF15	TRCN0000018515 TRCN0000018516 TRCN0000018513 TRCN0000018517 TRCN0000018514
229	PHF16	TRCN0000019554 TRCN0000019555 TRCN0000019556 TRCN0000019558 TRCN0000019557
230	PHF17	TRCN0000019621 TRCN0000019619 TRCN0000019620 TRCN0000019622 TRCN0000019623
231	PHF19	TRCN0000108185 TRCN0000108188 TRCN0000108189

		TRCN0000108187 TRCN0000108186
232	PHF20	TRCN0000016316 TRCN0000016313 TRCN0000016317 TRCN0000016314 TRCN0000016315
233	PHF21A	TRCN0000037003 TRCN0000037000 TRCN0000036999 TRCN0000037001 TRCN0000037002 TRCN0000124326
234	PHF23	TRCN0000019259 TRCN0000019263 TRCN0000019261 TRCN0000019262 TRCN0000019260
235	PHF3	TRCN0000019114 TRCN0000019115 TRCN0000019116 TRCN0000019117 TRCN0000019118
236	PHF8	TRCN0000118317 TRCN0000118318 TRCN0000118319 TRCN0000118320 TRCN0000118321
237	PML	TRCN0000003866 TRCN0000003867 TRCN0000003868 TRCN0000003869
238	POLR2B	TRCN0000021314 TRCN0000021315 TRCN0000021316 TRCN0000021317 TRCN0000021318
239	PPARGC1A	TRCN0000001165 TRCN0000001166 TRCN0000001167

		TRCN0000001168 TRCN0000001169
240	PRDM1	TRCN0000013608 TRCN0000013609 TRCN0000013610 TRCN0000013611 TRCN0000013612
241	PRDM10	TRCN0000016843 TRCN0000016844 TRCN0000016845 TRCN0000016846 TRCN0000016847
242	PRDM11	TRCN0000016888 TRCN0000016889 TRCN0000016890 TRCN0000016891 TRCN0000016892
243	PRDM12	TRCN0000017948 TRCN0000017949 TRCN0000017950 TRCN0000017951 TRCN0000017952
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245	PRDM14	TRCN0000018523 TRCN0000018524 TRCN0000018525 TRCN0000018526 TRCN0000018527
246	PRDM16	TRCN0000020044 TRCN0000020045 TRCN0000020046 TRCN0000020047 TRCN0000020048
247	PRDM2	TRCN0000013098 TRCN0000013099 TRCN0000013100

		TRCN0000013101 TRCN0000013102
248	PRDM4	TRCN0000015333 TRCN0000015334 TRCN0000015335 TRCN0000015336 TRCN0000015337
249	PRDM5	TRCN0000015258 TRCN0000015259 TRCN0000015260 TRCN0000015261 TRCN0000015262
250	PRDM8	TRCN0000016758 TRCN0000016759 TRCN0000016760 TRCN0000016761 TRCN0000016762
251	PRDM9	TRCN0000016803 TRCN0000016804 TRCN0000016805 TRCN0000016806 TRCN0000016807
252	PRKAA1	TRCN0000000857 TRCN0000000858 TRCN0000000859 TRCN0000000860 TRCN0000000861
253	PRKAA2	TRCN0000002168 TRCN0000002169 TRCN0000002170 TRCN0000002171 TRCN0000002172
254	PRKCD	TRCN0000010202 TRCN0000010193 TRCN0000010194 TRCN0000010203
255	PRMT1	TRCN0000035929 TRCN0000035930 TRCN0000035931 TRCN0000035932

		TRCN0000035933
256	PRMT2	TRCN0000035894 TRCN0000035895 TRCN0000035896 TRCN0000035897 TRCN0000035898
257	PRMT3	TRCN0000034569 TRCN0000034570 TRCN0000034571 TRCN0000034572 TRCN0000034573
258	PRMT5	TRCN0000107085 TRCN0000107088 TRCN0000107087 TRCN0000107089 TRCN0000107086
259	PRMT6	TRCN0000034684 TRCN0000034685 TRCN0000034686 TRCN0000034687 TRCN0000034688
260	PRMT7	TRCN0000035149 TRCN0000035150 TRCN0000035151 TRCN0000035152 TRCN0000035153
261	PRMT8	TRCN0000034749 TRCN0000034750 TRCN0000034751 TRCN0000034752 TRCN0000034753
262	PSIP1	TRCN0000074818 TRCN0000074819 TRCN0000074820 TRCN0000074821 TRCN0000074822
263	PYGO1	TRCN0000129967 TRCN0000148786 TRCN0000149986 TRCN0000128133

		TRCN0000130684
264	PYGO2	TRCN0000021861 TRCN0000021862 TRCN0000021863 TRCN0000021860 TRCN0000021859
265	RAG2	TRCN0000051228 TRCN0000051229 TRCN0000051230 TRCN0000051231 TRCN0000051232
266	RBBP4	TRCN0000115870 TRCN0000115867 RCN0000115868 TRCN0000115869 TRCN0000115871
267	RBBP5	TRCN0000034410 TRCN0000034413
268	RBBP7	TRCN0000038888 TRCN0000038887 TRCN0000038884 TRCN0000038886 TRCN0000038885
269	RCOR1	TRCN0000128570 TRCN0000129660 TRCN0000147184 TRCN0000128260 TRCN0000147902
270	RCOR2	TRCN0000143126 TRCN0000140491 TRCN0000140769 TRCN0000140462
271	RCOR3	TRCN0000116087 TRCN0000116089 TRCN0000116090 TRCN0000116091 TRCN0000116088 TRCN0000126692
272	RERE	TRCN0000013578 TRCN0000013579

		TRCN0000013580 TRCN0000013581 TRCN0000013582
273	RING1	TRCN0000021989 TRCN0000021990 TRCN0000021991 TRCN0000021992 TRCN0000021993
274	RNF2	TRCN0000033694 TRCN0000033695 TRCN0000033696 TRCN0000033697 TRCN0000033698
275	RNF20	TRCN0000033874 TRCN0000033875 TRCN0000033876 TRCN0000033877 TRCN0000033878
276	RNF40	TRCN0000004784 TRCN0000004780 TRCN0000004782 TRCN0000004781 TRCN0000004783
277	RNF6	TRCN0000033699 TRCN0000033700 TRCN0000033701 TRCN0000033702 TRCN0000033703
278	RPA1	TRCN0000010985 TRCN0000005984 TRCN0000010982 TRCN0000010983 TRCN0000005985
279	RPA3	TRCN0000018860 TRCN0000018861 TRCN0000018862 TRCN0000018863 TRCN0000018864
280	RSF1	TRCN0000128361 TRCN0000128484

		TRCN0000128604 TRCN0000148481
281	RUVBL1	TRCN0000018914 TRCN0000018912 TRCN0000018913 TRCN0000018910 TRCN0000018911 TRCN0000115241
282	RUVBL2	TRCN0000051564 TRCN0000051567 TRCN0000051565 TRCN0000051563 TRCN0000051566
283	SAP18	TRCN0000021663 TRCN0000021659 TRCN0000021660 TRCN0000021661 TRCN0000021662
284	SATB1	TRCN0000017173 TRCN0000017174 TRCN0000017175 TRCN0000017176 TRCN0000017177
285	SATB2	TRCN0000020688 TRCN0000020687 TRCN0000020684 TRCN0000020686 TRCN0000020685 TRCN0000140719
286	SCML2	TRCN0000019397 TRCN0000019395 TRCN0000019396 TRCN0000019394
287	SETD2	TRCN0000003029 TRCN0000003030 TRCN0000003031 TRCN0000003032 TRCN0000003033
288	SETD3	TRCN0000139106 TRCN0000121628

		TRCN0000122097 TRCN0000143148 TRCN0000143640 TRCN0000175757 TRCN0000134840 TRCN0000137191 TRCN0000134946 TRCN0000137911 TRCN0000137161
289	SETD5	TRCN0000098703 TRCN0000098704
290	SETD7	TRCN0000078628 TRCN0000078629 TRCN0000078630 TRCN0000078631 TRCN0000078632
291	SETD8	TRCN0000130139 TRCN0000130036 TRCN0000148268 TRCN0000128082
292	SFMBT1	TRCN0000146760 TRCN0000146761 TRCN0000147760 TRCN0000148746 TRCN0000147815
293	SFMBT2	TRCN0000148663 TRCN0000149533 TRCN0000149620 TRCN0000149672 TRCN0000146511
294	SIN3A	TRCN0000021774 TRCN0000021775 TRCN0000021776 TRCN0000021777 TRCN0000021778
295	SIN3B	TRCN0000107807 TRCN0000107805 TRCN0000107809 TRCN0000107808 TRCN0000107806

296	SIRT1	TRCN0000018979 TRCN0000018980 TRCN0000018981 TRCN0000018982 TRCN0000018983
297	SIRT2	TRCN0000040218 TRCN0000040219 TRCN0000040220 TRCN0000040221 TRCN0000040222
298	SIRT3	TRCN0000038890 TRCN0000038891 TRCN0000038892 TRCN0000038893
299	SIRT4	TRCN0000018944 TRCN0000018945 TRCN0000018946 TRCN0000018947 TRCN0000018948
300	SIRT5	TRCN0000018543 TRCN0000018544 TRCN0000018545 TRCN0000018546 TRCN0000018547
301	SIRT6	TRCN0000050473 TRCN0000050474 TRCN0000050475 TRCN0000050476 TRCN0000050477
302	SIRT7	TRCN0000020254 TRCN0000020255 TRCN0000020256 TRCN0000020257 TRCN0000020258
303	SMARCA1	TRCN0000050623 TRCN0000050624 TRCN0000050625 TRCN0000050626 TRCN0000050627
304	SMARCA2	TRCN0000020329

		TRCN0000020330 TRCN0000020331 TRCN0000020332 TRCN0000020333
305	SMARCA4	TRCN0000015548 TRCN0000015549 TRCN0000015550 TRCN0000015551 TRCN0000015552
306	SMARCA5	TRCN0000013213 TRCN0000013214 TRCN0000013215 TRCN0000013216 TRCN0000013217
307	SMARCAD1	TRCN0000050048 TRCN0000050051 TRCN0000050052 TRCN0000050049
308	SMARCAL1	TRCN0000083572 TRCN0000083568 TRCN0000083569 TRCN0000083570 TRCN0000083571
309	SMARCB1	TRCN0000010503 TRCN0000039583 TRCN0000039584 TRCN0000010504 TRCN0000039587 TRCN0000039585 TRCN0000010502 TRCN0000039586
310	SMARCC1	TRCN0000015628 TRCN0000015631 TRCN0000015629 TRCN0000015630 TRCN0000015632
311	SMARCC2	TRCN0000015698 TRCN0000015699 TRCN0000015701 TRCN0000015702

312	SMARCD1	TRCN0000151662 TRCN0000157022 TRCN0000153623 TRCN0000158153 TRCN0000157443 TRCN0000092957
313	SMARCD2	TRCN0000021267 TRCN0000021266 TRCN0000021265 TRCN0000021264 TRCN0000021268
314	SMARCE1	TRCN0000015778 TRCN0000015779 TRCN0000015780 TRCN0000015781 TRCN0000015782
315	SMYD1	TRCN0000129092 TRCN0000130477 TRCN0000130695 TRCN0000127839 TRCN0000128991
316	SMYD2	TRCN0000128189 TRCN0000130403 TRCN0000128349 TRCN0000130774
317	SMYD3	TRCN0000123289 TRCN0000123292 TRCN0000123293 TRCN0000123290 TRCN0000123291
318	SRCAP	TRCN0000021354 TRCN0000021355 TRCN0000021356 TRCN0000021357 TRCN0000021358
319	SSRP1	TRCN0000019269 TRCN0000019270 TRCN0000019271 TRCN0000019272 TRCN0000019273

320	SUDS3	TRCN0000038912 TRCN0000038909 TRCN0000038910 TRCN0000038911 TRCN0000038913 TRCN0000039314
321	SUPT16H	TRCN0000001257 TRCN0000001258 TRCN0000001259 TRCN0000001260 TRCN0000001261
322	SUV39H1	TRCN0000158337 TRCN0000150622 TRCN0000158270 TRCN0000157251 TRCN0000157285
323	SUV39H2	TRCN0000006935 TRCN0000006936 TRCN0000006937 TRCN0000011057 TRCN0000006938
324	Suv420h1	TRCN0000130417 TRCN0000129968 TRCN0000130307 TRCN0000128012 TRCN0000130388 TRCN0000039198
325	Suv420h2	TRCN0000141493 TRCN0000141926 TRCN0000143766 TRCN0000142036 TRCN0000141258 TRCN0000039200
326	SUZ12	TRCN0000038724 TRCN0000038725 TRCN0000038726 TRCN0000038727 TRCN0000038728
327	TADA2L/TADA2A	TRCN0000017299 TRCN0000017298

		TRCN0000017302 TRCN0000017301 TRCN0000017300
328	TADA3/TADA3L	TRCN0000015737 TRCN0000015733 TRCN0000015736 TRCN0000015734 TRCN0000015735
329	TAF1	TRCN0000006284 TRCN0000006285 TRCN0000006286 TRCN0000006287 TRCN0000006288
330	TAF3	TRCN0000016608 TRCN0000016609 TRCN0000016610 TRCN0000016611 TRCN0000016612
331	TBL1X	TRCN0000118647 TRCN0000118648 TRCN0000118649 TRCN0000118650 TRCN0000118651
332	TDRD3	TRCN0000073294 TRCN0000073293 TRCN0000073295 TRCN0000073296 TRCN0000073297
333	TET1	TRCN0000075027 TRCN0000075025 TRCN0000075024 TRCN0000075026 TRCN0000075023
334	TET2	TRCN0000122172 TRCN0000139778 TRCN0000142853 TRCN0000144344 TRCN0000145351
335	TLK1	TRCN0000007056 TRCN0000007057

		TRCN0000007058 TRCN0000007059 TRCN0000007060
336	TLK2	TRCN0000002361 TRCN0000002362 TRCN0000002363 TRCN0000002364 TRCN0000002365
337	TRIM24	TRCN0000021260 TRCN0000021259 TRCN0000021262 TRCN0000021263 TRCN0000021261 TRCN0000088522
338	TRIM28	TRCN0000017999 TRCN0000018002 TRCN0000018000 TRCN0000018001 TRCN0000017998
339	TRIM33	TRCN0000022008 TRCN0000022004 TRCN0000022005 TRCN0000022006 TRCN0000022007 TRCN0000007228
340	TRP53BP1	TRCN0000081779
341	TRRAP	TRCN0000005363 TRCN0000005361 TRCN0000005362 TRCN0000005364 TRCN0000005365
342	UBE2A	TRCN0000010842 TRCN0000004005 TRCN0000004006 TRCN0000004007 TRCN0000004008
343	UBE2B	TRCN0000004009 TRCN0000004010 TRCN0000004011 TRCN0000004012

		TRCN0000004013
344	UBE2E1	TRCN0000004014 TRCN0000004015 TRCN0000004016 TRCN0000004017 TRCN0000004018
345	UBE2I	TRCN0000011077 TRCN0000007205 TRCN0000007206 TRCN0000011078 TRCN0000007207 TRCN0000011078 TRCN0000011077
346	UHRF1	TRCN0000004353 TRCN0000004352 TRCN0000004356 TRCN0000004354 TRCN0000004355 TRCN0000112188
347	UHRF1BP1	TRCN0000064774 TRCN0000064777 TRCN0000064776 TRCN0000064773 TRCN0000064775 TRCN0000073848
348	UHRF2	TRCN0000003479 TRCN0000003481 TRCN0000003480 TRCN0000003482 TRCN0000010793 TRCN0000040626
349	USP22	TRCN0000046924 TRCN0000046925 TRCN0000046926 TRCN0000046927
350	USP51	TRCN0000038849 TRCN0000038850 TRCN0000038851 TRCN0000038852 TRCN0000038853

351	UTX	TRCN0000107760 TRCN0000107761 TRCN0000107762 TRCN0000107763 TRCN0000107764
352	WDR5	TRCN0000118047 TRCN0000118048 TRCN0000118049 TRCN0000118050 TRCN0000118051
353	WDR54	TRCN0000072663 TRCN0000072664 TRCN0000072665 TRCN0000072666 TRCN0000072667
354	WDR82	TRCN0000130689 TRCN0000129877 TRCN0000128304 TRCN0000127796 TRCN0000130791
355	WHSC1	TRCN0000019814 TRCN0000019815 TRCN0000019816 TRCN0000019817 TRCN0000019818
356	WHSC1L1	TRCN0000015613 TRCN0000015614 TRCN0000015615 TRCN0000015616 TRCN0000015617
357	WNT5A	TRCN0000062713 TRCN0000062714 TRCN0000062715 TRCN0000062716 TRCN0000062717
358	YEATS4	TRCN0000013143 TRCN0000013144 TRCN0000013146 TRCN0000013145 TRCN0000013147

359	ZCWPW1	TRCN0000139148 TRCN0000140908 TRCN0000145000 TRCN0000139000 TRCN0000140405
360	ZFPM1	TRCN0000107406 TRCN0000107408 TRCN0000107407 TRCN0000107405 TRCN0000107409
361	ZMYND11	TRCN0000021253 TRCN0000021251 TRCN0000021252 TRCN0000021249 TRCN0000021250 TRCN0000088135
362	ZMYND8	TRCN0000037997 TRCN0000037996 TRCN0000037998 TRCN0000037995 TRCN0000037994 TRCN0000007228
363	ZNFX1	TRCN0000017371 TRCN0000017369 TRCN0000017372 TRCN0000017368 TRCN0000017370 TRCN0000073848

Table S2: List of genes for which multiple shRNAs were isolated from the epigenome-wide shRNA screen.

S.No.	Gene Symbol	Gene Name	Accession Number
1	***BOP1***	Block of Proliferation	NM_015201.4
2	***HAT1***	Histone acetyltransferase 1	NM_003642.3
3	***HMGB1***	High mobility group protein B1	NM_001313892
4	***HMGN1***	High mobility group nucleosomal binding protein 1	NM_004965.6
5	***ING5***	Inhibitor of growth 5	NM_001330161.1
6	***KDM4C***	Lysine-specific demethylase 4C	NM_001146695

Table S3: Patient sample information used for BOP1 expression analysis.

S.No.	SAMPLE ID	STAGE	MUTATION	TREATMENT	RESPONSE	SAMPLES ANALYZED	BOP1 PROTEIN EXPRESSION IN PROGRESSED SAMPLES
Pair 1	#1218	IV M1c	V600E	Seq. BRAFi + MEKi	SD	Matched Pre- and progressed	Downregulated
Pair 2	#1117	IV M1c	V600E	Dual BRAFi + MEKi	PR	Matched Pre- and progressed	Downregulated
Pair 3	#848	IV M1c	V600E	Dual BRAFi + MEKi	PR	Matched Pre- and progressed	Downregulated
Pair 4	#757	IV M1c	V600E	BRAFi	PR	Matched Pre- and progressed	Downregulated
Pair 5	#0470	IV M1c	V600K	BRAFi	PR	Matched Pre- and progressed	Downregulated
Pair 6	#0959	IV M1a	V600E	BRAFi	PR	Matched Pre- and progressed	Downregulated
Pair 7	#0923	IV M1c	V600E	Dual BRAFi + MEKi	PR	Matched Pre- and progressed	Downregulated
Pair 8	#2132	IV M1c	V600E	Dual BRAFi + MEKi	PR	Matched Pre- and progressed	Unchanged
Pair 9	#1351	IV M1a	V600E	Seq. BRAFi + MEKi	PR	Matched Pre- and progressed	Unchanged
Pair 10	#1577	IV M1c	V600E	Dual BRAFi + MEKi	PR	Matched Pre- and progressed	Upregulated
Pair 11	#1254	IV M1c	V600E	BRAFi	PR	Matched Pre- and progressed	Upregulated

SD: Stable disease
PR: Partial response
Seq: Sequential

Table S4: Primer sequences, clone IDs, catalog numbers, antibodies, and chemical inhibitors used in this study. Primers were used for qRT-PCR analysis. The shRNAs used herein were obtained from Open Biosystems; clone IDs and catalog numbers are listed. The antibodies were used for immunoblot analyses. The source and concentrations of chemical inhibitors used for drug treatment experiments are summarized.

Application	Gene symbol	Forward primer (5′-3′)	Reverse primer (5′-3′)
RT-qPCR	*BOP1*	aggactcggtgctgctgctg	cccacttggcgctcctcctc
	HAT1	tggcgatagaggcacaacag	acacgccggtaatcttccac
	KDM4C	gcagacaccgggttaagagg	cttctcgcaagccttggact
	HMGB1	ggagaacatcctggcctgtc	cagcttcgcagccttctttt
	HMGN1	aaacaggccgaagtggctaa	agggagacagggaccactga
	ING5	cccaaacgaacccacgtact	gggtttcgtggtaaggtcca
	DUSP1	tgtggaggacaaccacaagg	aaactcaaaggcctcgtcca
	DUSP2	ctgtcccgatctgtgctctg	ccatctggttgtcctccaca
	DUSP4	gaggggaatggacaccacat	tgtctccctccaaagccatt
	DUSP5	ggatccctgtggaagacagc	gaccatgctcctcctctgct
	DUSP6	ttgagacgctcgctgtttgt	agccgctggctcttagtgtc
	DUSP7	ctcggcaagtatggcatcaa	ggtcagagatggggatctgc
	DUSP8	cgccctctctgctgtttctt	gacagagggaacgggaacag
	DUSP9	cacacatctggtgggctgtt	cacaggggtgtggacagaaa
	DUSP10	ccgacctcaggatctcaacc	ccttgtcgtaggttgccaca
	DUSP16	cagactcccgaaaccagtcc	ccagcagacttcgtgaggtg
	MX-YTX	cacccaagaggtggaagagg	ctccaagggcagaaggaatg
	SPRY1	cccaagcaactgattgtgga	Gtagggtcctgggagcagtg
	SPRY2	agtcgtctccagctccgaac	Ctctgagctctggcctccat
	PP2A	atcttgccctgcatcaagga	Tctttgcccagaatgggaga
	PP2C	tgtcatgcgcatcttgtctg	tcagcagggctttcttctcc
	HePTP	caccacactttggccctgta	actttccccagacccacctt
	DUSP3	gtgtgcatggatgtgtgtgg	tcatgtctgcctggctgagt
	PTP-SL	ggcataaaggtggcttctgc	agcctcgaaaatgggacaga
	STEP	tgtgtctcctcagccaggaa	tgcctaactccccgtcatct
	CIRH1A	caggcagcgctgttcataag	gtcccagaactgcaccttcc
	DKC1	tgggagttggtggtcagatg	tcaatgccgtcctcatatcg
	EMG1	acccgaattcccagaacctt	ggcccctaccacaaaaacaa
	HCA66	aaggtgccaaaagccaagaa	ctgaaaatggtcggctctcc
	NHP2	tcacgcggaagctctacaaa	gagcccctcatagggtagg
	RBM28	cctaccaaagccagcgtttc	gtccggccttttcagtcac
	RMRP	acgtagacattccccgcttc	acgcactgcctgcgtaacta
	RPL11	caggtttcagcatcgcagac	cgggaatttatttgccagga
	RPL35A	aaggccatttttgctggcta	gaaccatgccactgtttcca
	RPL36	caacaagggccacaaagtga	gggaggggctcagtctttct
	RPL5	cggaaacgcttggtgataca	gtcacctccacttggccttc
	RPS14	tgtgactggtgggatgaagg	ggtgatacccagctccttgc
	RPS15	agaagccggaagtggtgaag	atggagaactcgcccaggta

	RPS17	gccattatccccagcaaaaa	gccattatccccagcaaaaa
	RPS19	acgaactttcgccctgagag	gggagcaagctctttgtgct
	RPS24	tttggtggtggcaagacaac	tttgcagtccccctgacttt
	RPS27A	catttggtgtggtcgcctaa	ctcgagggtgatggtcttcc
	RPS7	tcccaggagaaagccatgtt	ctccagaagagcctgggaga
	SBDS	gacggctgcctgaagctagt	taccacggccacattggtta
	TCOF1	tgagctgctggaacaggaaa	ccttggaagtcgtggaggtc
	UTP14C	aaagcccagtgccaagaaaa	aggggtctggatggtccttt
	WDR36	caaggaagcctgcagttgtg	aatatggccacatgggcttc
	NOP10	ctcggttctccccagatgac	agggctcacagtccgaagag
	WDR12	tggctcagctccaaacacgct	ggcaattcagaggcagcaggga
	PES1	gggcacctacgcgttggact	tccacctcggcctcctcctc
	28S	agaggtaaacgggtggggtc	ggggtcgggaggaacgg
	U1	ccatgatcacgaaggtggttt	atgcagtcgagtttcccacat
	SP6	catacgatttaggtgacactatag	
	MF18	tacgatacaaggctgttagagag	
	MF19	cgaaccgcaaggaaccttc	
shRNAs	**Gene symbol**	**Clone ID**	**Catalog number**
	BOP1	TRCN0000078069	RHS3979-97066366
		TRCN0000078071	RHS3979-97066368
	HAT1	TRCN0000034735	RHS3979-9602143
		TRCN0000034737	RHS3979-9602145
	KDM4C	TRCN0000022056	RHS3979-9589464
		TRCN0000022058	RHS3979-9589466
	HMGB1	TRCN0000018932	RHS3979-9586254
		TRCN0000018934	RHS3979-9586256
	HMGN1	TRCN0000019059	RHS3979-9586467
		TRCN0000019060	RHS3979-9586468
	ING5	TRCN0000020090	RHS3979-9587498
		TRCN0000020092	RHS3979-9587500
	DUSP4	TRCN0000006842	RHS3979-9575763
		TRCN0000006843	RHS3979-9575764
	DUSP6	TRCN0000002437	RHS3979-9571003
		TRCN0000010706	RHS3979-9571004
	RPL11	TRCN0000117714	RHS3979-98059637
		TRCN0000117716	RHS3979-98059653
	RPS24	TRCN0000117547	RHS3979-98059466
		TRCN0000117548	RHS3979-98059474
	WDR12	V3LHS_311782	RHS4430-101164454
		V2LHS_156548	RHS4430-99613637
	PES1	V3LHS_304461	RHS4430-101034784
		V3LHS_304460	RHS4430-101031539

	Protein symbol	Antibody source	Dilution
Immunoblotting	Actin	Cell signaling	1:5000
	KDM4C	Active Motif	1:1000
	HMGB1	Cell signaling	1:2000
	ING5	Santa Cruz Biotechnology	1:200
	HAT1	Santa Cruz Biotechnology	1:200
	P-ERK1/2	Cell signaling	1:2000
	T-ERK1/2	Cell signaling	1:2000
	DUSP4	Cell signaling	1:2000
	BOP1	Santa Cruz Biotechnology	1:200
	V5	Cell signaling	1:2000
	RPL11	Cell signaling	1:2000
	RPS24	Thermofischer scientific	1:1000
	TP53	Santa Cruz Biotechnology	1:200
	HMGN1	Active Motif	1:1000
Immuno-fluorescence	GM113	BD Biosciences	1:200
	BOP1	Sigma Aldrich	1:250
	S100	Biogenex Laboratories	1:100
	HMB45	Biogenex Laboratories	1:100
	Alexaflour546	Invitrogen	1:100
	Cy5-Thyramide	Perkin Elmer	1:50
Inhibitors		**Concentration**	**Source**
	Vemurafenib	0.1 μM, 1 μM and 2 μM	Selleckchem
	Dabrafenib	50 nM and 100 nM	Selleckchem
cDNA/ORF	***Accession number***	**Clone ID**	**Source**
DUSP4	BC002671	ccsbBroad304_06130	Dharmacon
DUSP6	BC037236	ccsbBroad304_00468	Dharmacon