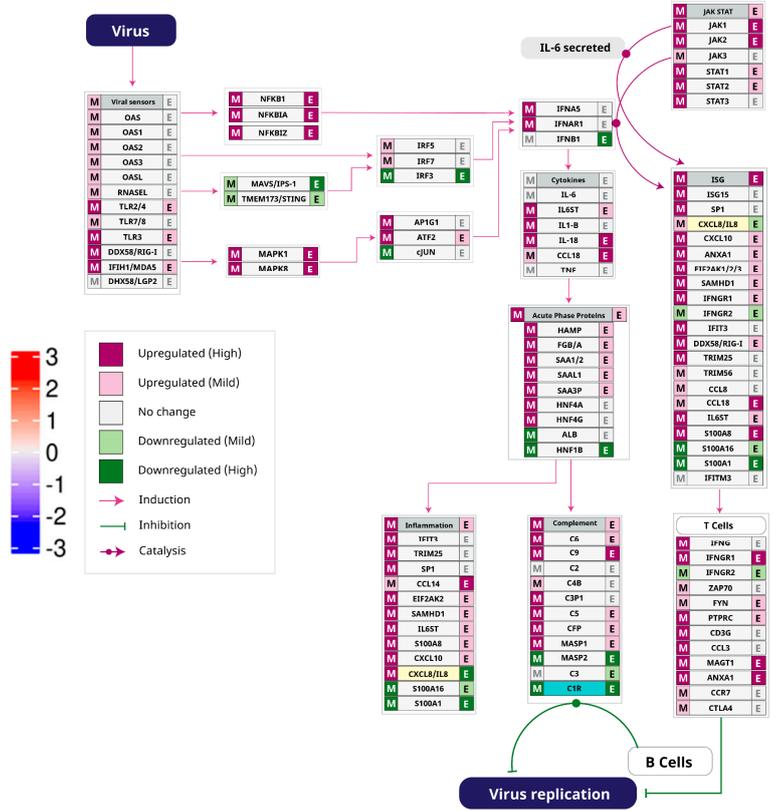
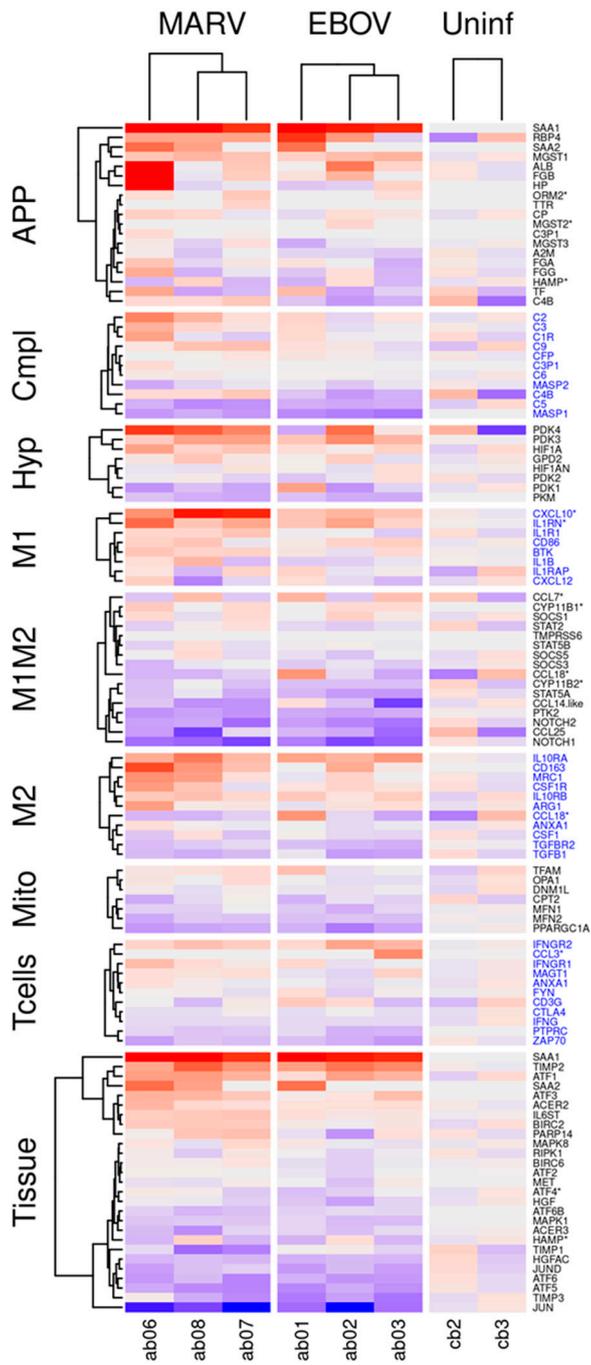
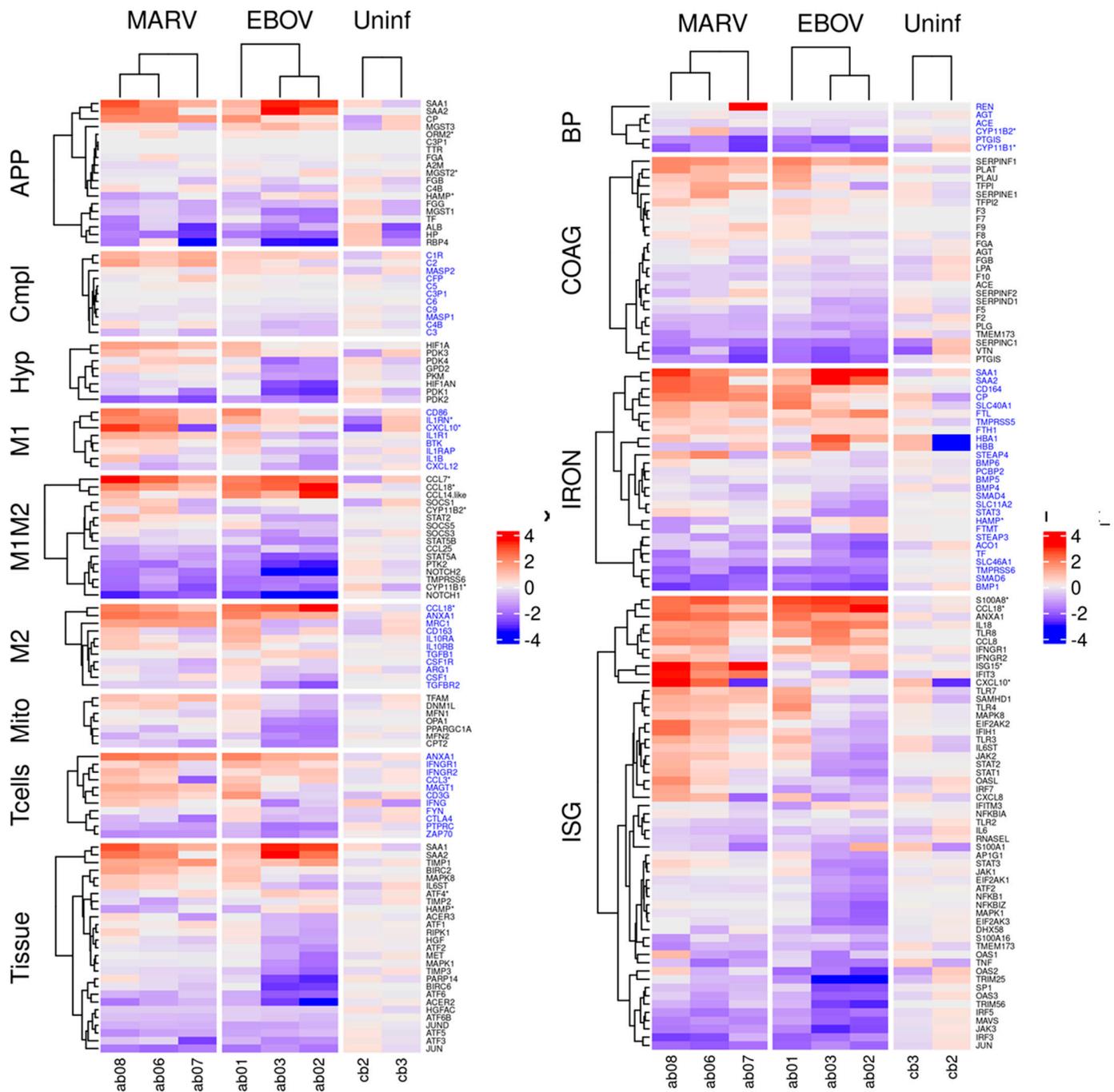


Figure S1. A multidimensional scaling (MDS) plot of the merged gene expression data from kidneys of MARV-infected, EBOV-infected and uninfected bats. The plot shows a clear separation between MARV infections, EBOV infections and the uninfected samples. The virus-specific signatures in this plot, along with that for livers and spleens (Fig. 2), demonstrate that the identified transcriptional responses to filovirus infections extends to the whole animal.



A



B

Figure S2. (A). Differential expression of genes belonging to the indicated pathways by MARV and EBOV infections of bats in kidneys. Left panel: genes related to acute phase response (APP), complement system (Cmpl), hypoxia (Hyp), tissue regeneration and apoptosis (Tissue), and genes specific to macrophages in the M1 state (M1), M2 state (M2) and, common to M1 and M2 states (M1M2). Right panel: genes related blood pressure (BP), coagulation (COAG), iron homeostasis (IRON) and interferon stimulated genes (ISG). The columns show samples from three MARV-infected bats, three EBOV-infected bats and two uninfected bats. The values are \log_2 of the fpm values, with the mean value of the samples from uninfected bats subtracted. The data show virus-specific responses which are not as pronounced as in the liver (Fig. 4); the responses are greater for MARV. Renin, in the BP group of gene, is only expressed in kidneys. There is a strong response in the SAA1/2 APP genes. * Genes whose bat versions are diverged from their human counterparts. Alternate blocks of gene names are colored black/blue to enable easy visual

distinction of the blocks. **(B). Differential expression of genes belonging to the indicated pathways by MARV and EBOV infections of bats in spleens.** Left panel: genes related to acute phase response (APP), complement (Cmpl), hypoxia (Hyp), tissue regeneration / apoptosis (Tissue), and genes specific to macrophages in the M1 state (M1), M2 state (M2) and, common to M1 and M2 states (M1M2). Right panel: genes for blood pressure (BP), coagulation (COAG), iron homeostasis (IRON) and Interferon stimulated genes (ISG). The columns show the samples from three MARV-infected bats, three EBOV-infected bats and two uninfected bats. The values are log₂ of the fpm values, with the mean value of the uninfected samples subtracted. The virus-specific response was not as pronounced as in the liver (Fig. 4) or kidneys (Fig. S2A), with larger effects in the case of MARV. A strong response in expression of the SAA1/2 APP genes was observed. Sting (TMEM173) expression was only detected in the spleen. * Genes whose bat versions are diverged from their human counterparts. Alternate blocks of gene names are colored black/blue to enable easy visual distinction of the blocks.

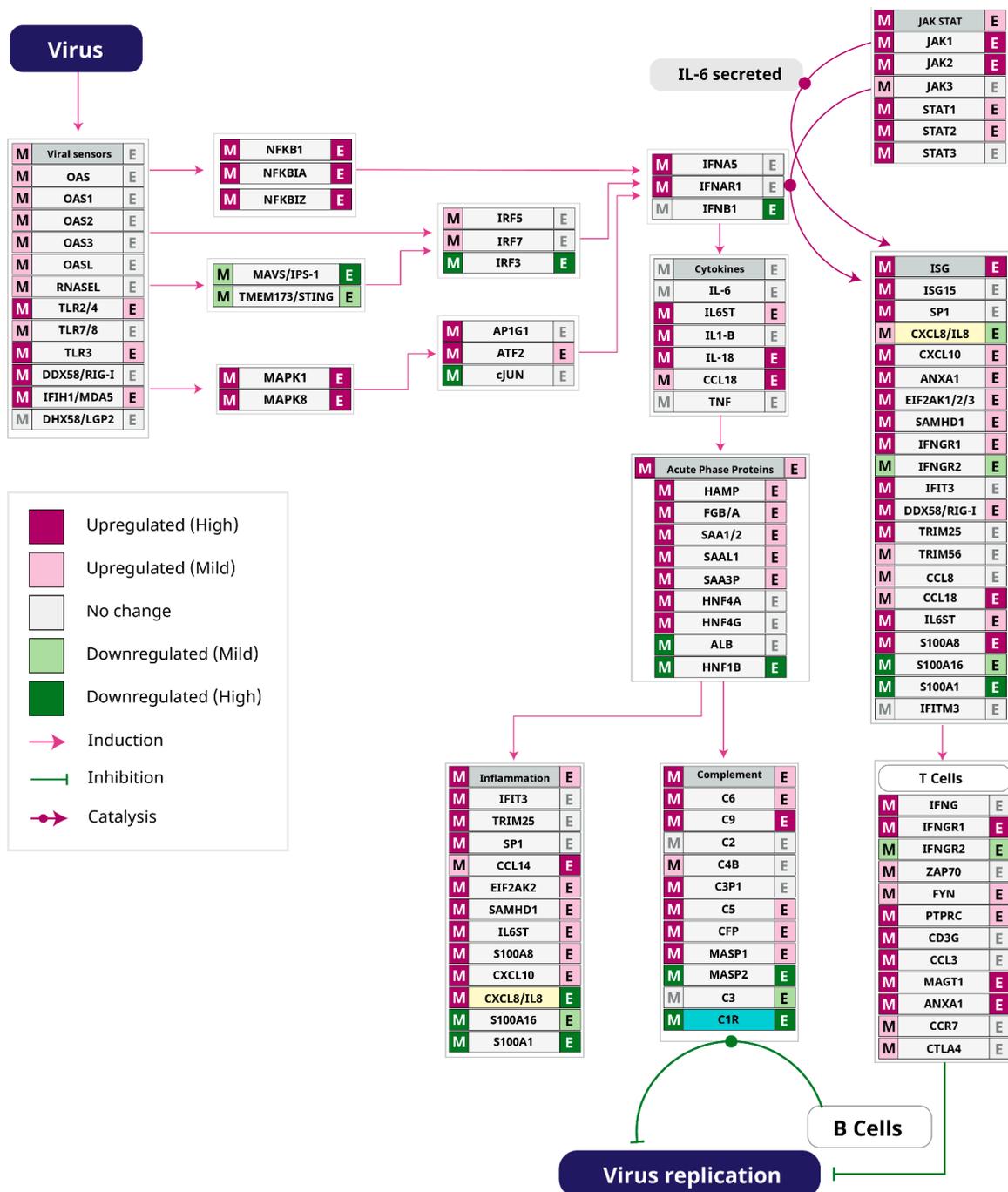


Figure S3. Pathway analysis of innate response to filovirus infections in bats. Viral RNA and proteins are detected by innate immune sensors, leading to upregulation of type I interferons (IFN α and IFN β) and interferon stimulated genes (ISG) through the JAK-STAT pathway. Cytokines and chemokines create an anti-viral state in the cell. Inflammation (in part mediated by IL-6) triggers expression of acute phase proteins (APPs). Secretion of interferon- γ enables an adaptive immune response. In human and bat cells responses to the filoviruses were mostly similar, with a few virus-specific differences. VP35 from both viruses interferes with IRF3/7, while EBOV VP24 inhibits STAT1, and MARV-VP40 inhibits JAK1, which can lead to differences in responses to MARV and EBOV. The robust innate response to filovirus infection in bats and humans suggests any constitutive expression of innate response genes in bats is unlikely to be relevant to explain the difference in the pathogenesis. **Fig. 4** shows the relative changes in expression upon infection for these genes. Here, colored bands flanking gene names depict the effect of filovirus infection on gene expression for MARV (left) and EBOV (right).

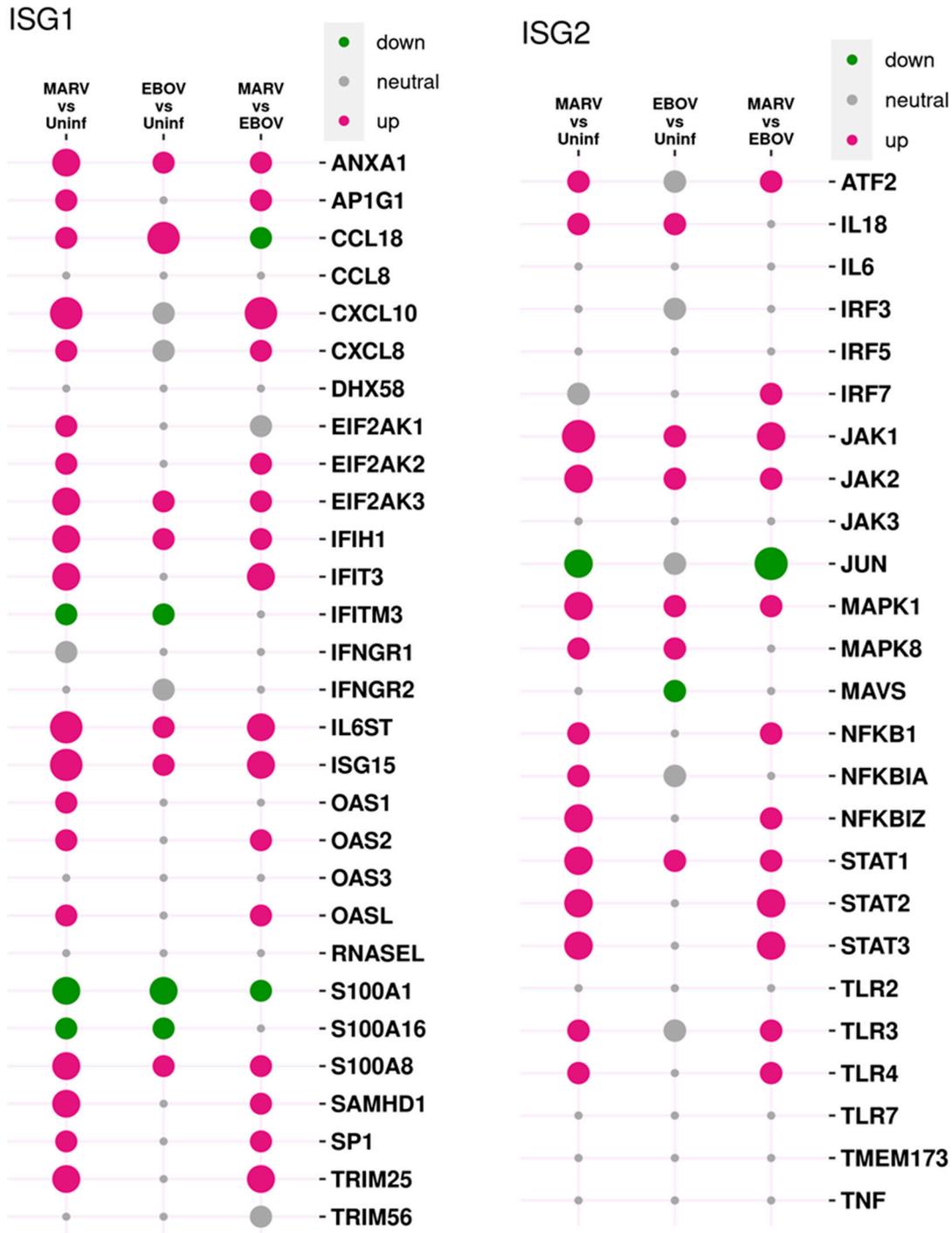


Figure S4. Induction of interferon stimulated genes (ISG) in livers of filovirus-infected bats. MARV and EBOV elicit a strong innate response driven by IFNs. The balloon plot shows comparisons of responses of ISG genes to MARV and EBOV against uninfected animals and against each other. The radius of circle is proportional to $\log_2(\text{ratio})$, red is $\log_2(\text{ratio}) > 0.6$, green is $\log_2(\text{ratio}) < -0.6$, gray is $-0.6 < \log_2(\text{ratio}) < 0.6$. The response is stronger in the MARV infected animals, corresponding to the greater replication of MARV as compared to EBOV in ERBs.

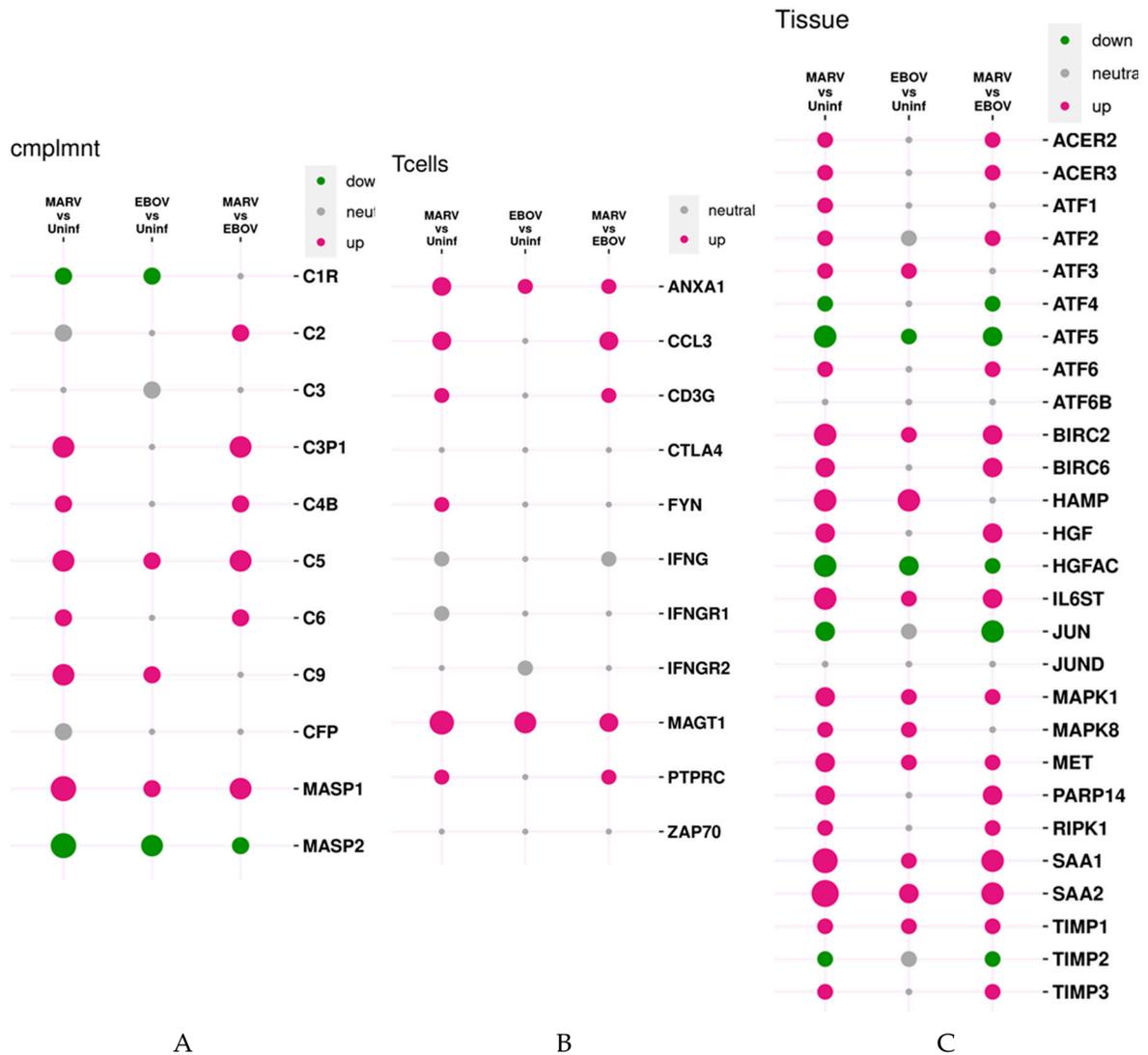


Figure S5. Tissue regeneration, the complement system and CD8⁺ T cells. Responses of genes in MARV and EBOV infected bats against uninfected bats and against each other. Balloon plots with the radius of circles proportional to $\log_2(\text{ratio})$, gray is used when absolute values of $\log_2(\text{ratio}) < 0.6$. **A.** The complement system: filovirus infections downregulated C1R, C3 and MASP2, likely leading to reduced antibody activities. **B.** CD8⁺ T cell genes: most of them were upregulated by filovirus infections, indicating a CD8⁺ T cell response, which is likely to be involved in clearance of filovirus infections in bats. **C.** Tissue regeneration: filovirus infections in bats eventually trigger tissue regeneration, reflected in the activation of M2 macrophages, which are anti-inflammatory and promote regeneration of tissues. The greater effect of MARV infection as compared to EBOV is consistent with the higher viral loads.

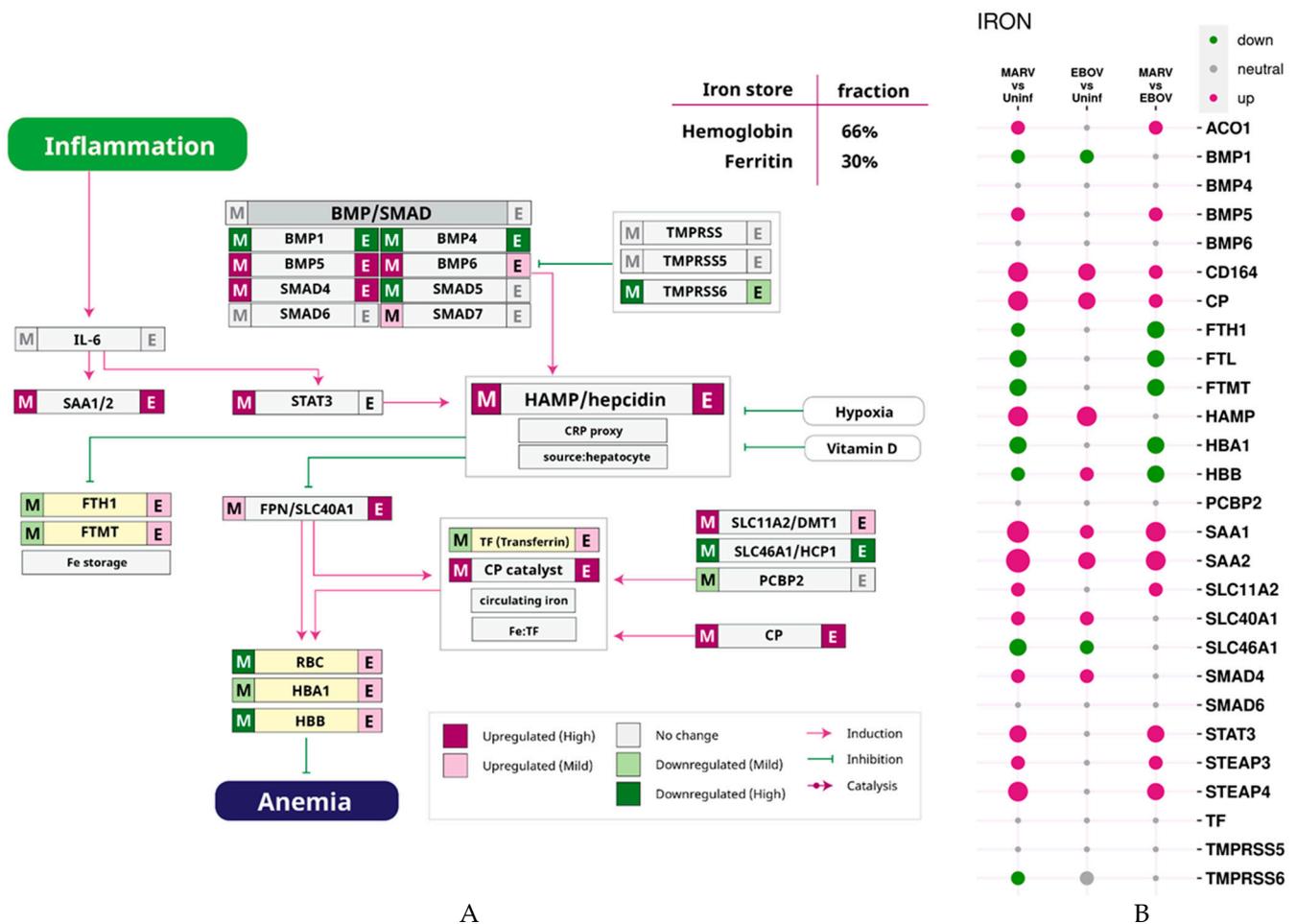


Figure S6. Iron metabolism. **A.** Pathway analysis of genes involved in iron homeostasis. Colored bands flanking gene names depict the effect of filovirus infection on gene expression for MARV (left) and EBOV (right), with upregulation depicted by shades of red and downregulation depicted by shades of green. The lines show induction (red) and inhibition (green). Filovirus infections lead to upregulation of HAMP. In MARV infection, this may lead to a decrease in blood iron levels and impaired hematopoiesis, but in EBOV infection, this regulation seems to be broken, leading to a high iron state. These differences between MARV and EBOV infections are consistent with the greater replication of MARV in ERBs. ACO1 is upregulated during filovirus infections, suggesting the cytosol has abundant iron. **B.** The balloon plot compares responses of genes in MARV and EBOV infected bats against uninfected bats and against each other. The radius of circle is proportional to $\log_2(\text{ratio})$, grey is used when absolute values of $\log_2(\text{ratio}) < 0.6$.

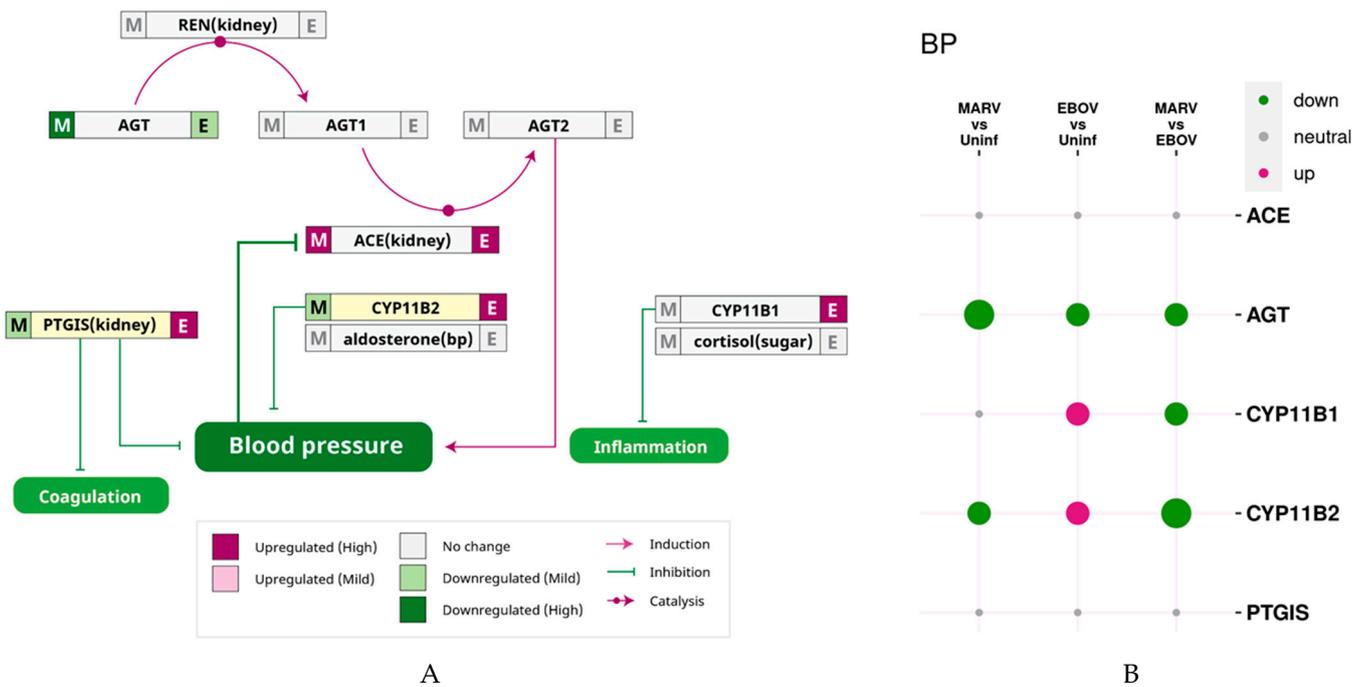
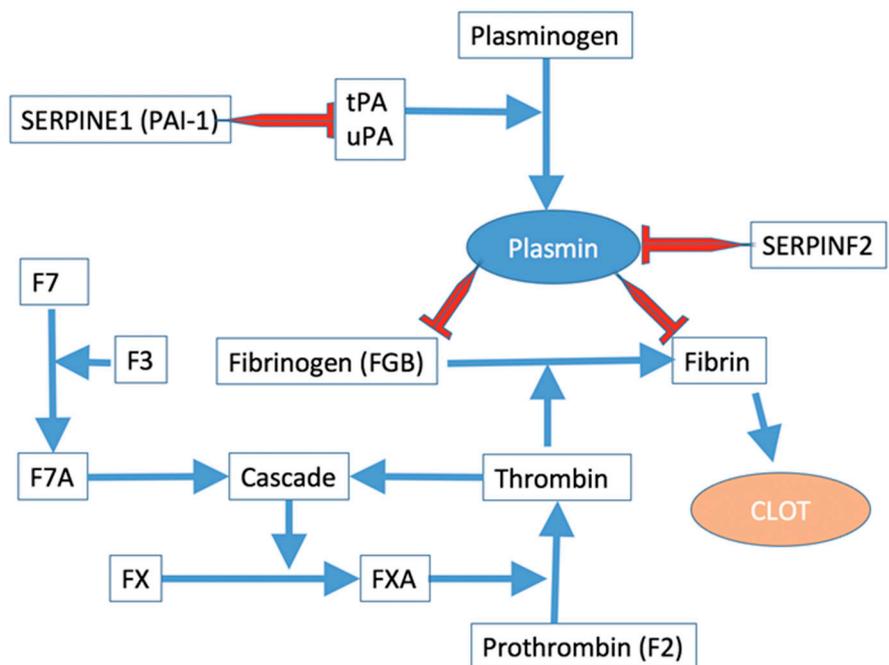


Figure S7. Blood pressure pathways. **A.** Analysis of pathways associated with renin (REN) and angiotensin I-converting enzyme (ACE) which catalyze conversion of AGT to AGT2, which in turn constricts blood vessels to increase pressure. Filovirus infections in ARBs lowered expression of AGT but increased PTGIS, which reduces blood pressure and coagulation and increased ACE, which is a sensor of low blood pressure. Thus, filovirus-infected bats induces an anti-coagulative state with low blood pressure. The colored bands on either side of the gene names depict the effects of MARV (left) and EBOV (right) infections on expression of the indicated genes. **B.** The balloon plot compares responses of genes to MARV and EBOV compared to uninfected animals and against each other. The radius of circle is proportional to $\log_2(\text{ratio})$, gray is used when absolute values of $\log_2(\text{ratio}) < 0.6$.



the clot. There is an opposing process where plasmin degrades fibrinogen and fibrin thereby dissolving clots. The figure only shows processes that are relevant to the discussion in the paper. The red lines show inhibition of a process or degradation, while the blue arrows signify enhancement of the process/product. The process starts with tissue factor (F3) activating F7 (to form F7A) which eventually leads to the formation of Thrombin, which facilitates fibrin synthesis. **Fig. S9** shows the expression changes in coagulation pathway genes upon filovirus infections.

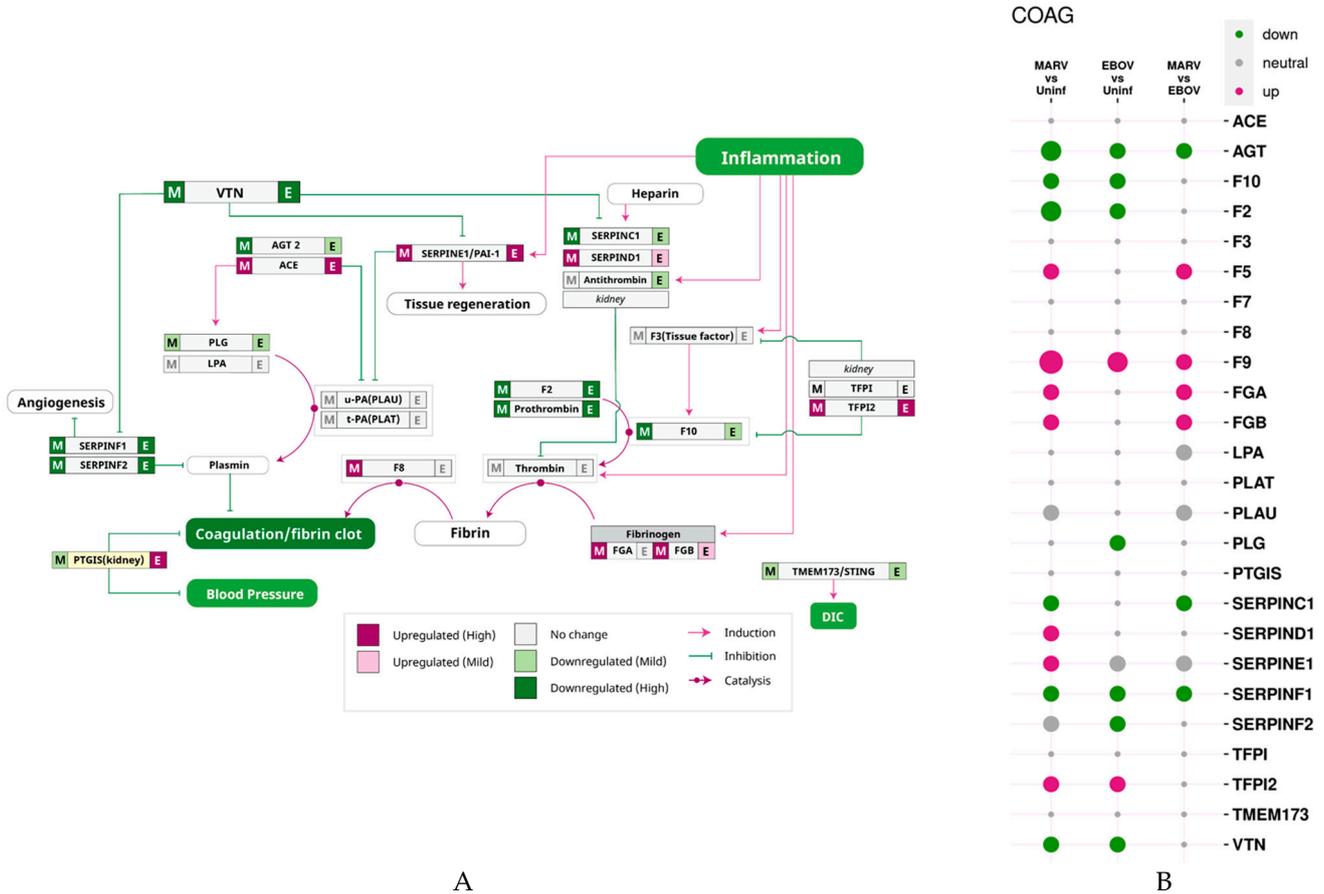


Figure S9. Details of the coagulation pathway. A. Analysis of pathways associated with coagulation cascade (shown in Fig. S8). Except for F3, the tissue factor, all other proteases in the cascade require activation. The serine protease plasmin opposes this process by attacking the fibrin mesh to dissolve clots. Urokinase-type plasminogen activator (uPA, PLAU gene) activates plasminogen to generate plasmin. SERPINE1 (PAI-1) inhibits the activity of uPA, blocking the creation of plasmin, thereby stabilizing clots. SERPINF2 also stabilizes clots by directly inhibiting plasmin. PTGIS creates prostacyclin, which prevents platelet aggregation, yet another path for inhibiting clot formation and coagulation. Prostacyclin is also a potent vasodilator. Failure in the control of plasmin (e.g., inactivation of SERPINF2 which inhibits plasmin) can lead to hemorrhagic diathesis, while blocking plasmin activity can lead to excessive clotting. Filovirus infections in bats lead to low F2 (which lowers fibrin) and raise levels of PTGIS, which suggest that filovirus-infected bats are in a low coagulation state. B. The balloon plot compares responses of genes to MARV and EBOV compared to uninfected animals and against each other. The colored bands on either side of the gene names depict the effects of filovirus infections on gene expression for MARV (left) and EBOV (right) compared to uninfected animals. The radius of circle is proportional to $\log_2(\text{ratio})$, gray is used when absolute values of $\log_2(\text{ratio}) < 0.6$.

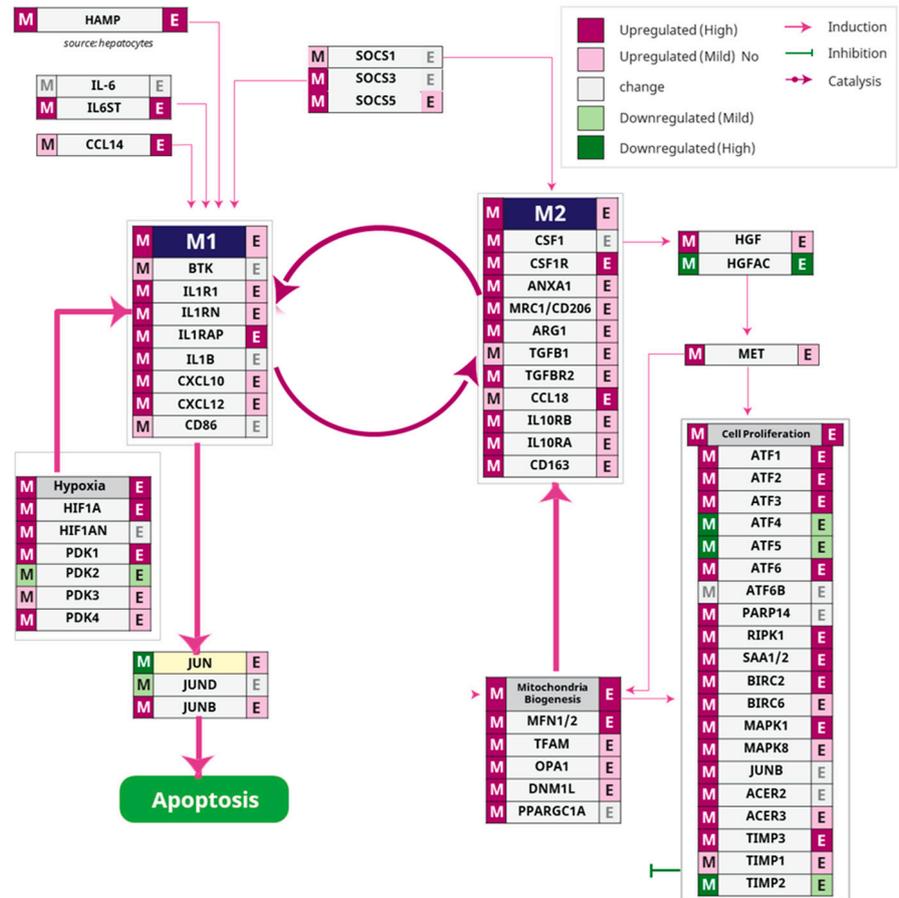


Figure S10. Pathway analysis related to macrophage polarization during filovirus infections. Differential expression of genes involved in macrophage polarization between the pro-inflammatory M1 state and the anti-inflammatory M2 state. Colored bands flanking gene names depict the effects of MARV (left) and EBOV (right), with upregulation depicted by shades of red and downregulation depicted by shades of green. The lines show induction (red) and inhibition (green). Filoviral infections initially lead to proinflammatory state of macrophages (M1) which then transitions to anti-inflammatory state (M2). The differential expression levels of these genes as balloon plots is shown in Fig. S5. HAMP induces macrophages in the proinflammatory M1 state which phagocytose infected cells and induces apoptosis. In contrast, the M2 macrophages induce cell proliferation and tissue regeneration. Different SOCS family molecules serve as molecular switches that control M1/M2 macrophage switch. Fatty acid oxidation and increased mitochondrial numbers and activity indicates an M1 to M2 switch. During filoviral infections, both M1 and M2 states are seen, based on the markers specific to them, but the ratio of M1 to M2 was skewed more towards M2 in EBOV-infected bats case, consistent with the more limited virus replication, while the M1 to M2 transition was still underway in the MARV-infected bats. The switch to the M2 state is probably the key to the resilience of bats during filovirus infections, allowing bats to tolerate filovirus infections without significant adverse effects. There is also a connection between iron metabolism and macrophage M1/M2 polarization with increasing iron (Fig. S6) favoring the M2 state.



Figure S11. Macrophage activation. Left panel(A): genes common to both M1 and M2 states. Top right panels (B,C): genes involved in hypoxia and mitochondrial respiration/abundance. Bottom right panels(D,E): genes specific to the M1 and M2 macrophages which show that both M1 and M2 states are activated by filovirus infections with the M1/M2 ratio being higher in MARV infection. The balloon plots shows comparisons of gene expression responses to MARV and EBOV in comparison with uninfected animals. The radius of circle is proportional to $\log_2(\text{ratio})$, gray is used when absolute values of $\log_2(\text{ratio}) < 0.6$. There are more activated macrophages in the MARV-infected bats compared to EBOV-infected bats, consistent with greater level of MARV replication.

Table S1. List of bat samples profiled using mRNA-seq.

Tissue	Uninfected	MARV	EBOV
Liver	3	3	3
Lung	0	3	3
Spleen	3	3	3
Kidney	3	3	3

Table S2. MARV transcripts detected using mRNAseq in tissues of MARV-infected bats.

Organ	ab07	ab08	ab06
Liver	79	8.7	3.1
Spleen	56	8.5	3.4
Large intestine	2.3	10.1	NA
Lung	2.3	0	NA

NA, not analyzed, stands for samples that failed mRNAseq. The values are expressed in tpm. EBOV transcripts are seen only in liver in very low numbers.

Table S3. Divergent pathways and genes upregulated by MARV and EBOV infection: vascular, mitochondrial, oxidation-reduction, innate immunity, T cell activity, complement, digestion, toxins, inflammation and tissue regeneration.

Gene	Process	em_div_up1		
	Vascular			
HAMP/Hepcidin	Cellular iron ion homeostasis inflammatory induces M1 macrophages			
SRGN	Platelet degranulation			
AK3	Platelet production nucleoside diphosphate phosphorylation mitochondrial			
GLRX	Antioxidant defense system VEGF expression vascular growth			
CEBPZOS	Blood cell maturation			
MRPL50	Mitochondrial			
GSTZ1	Organelle organization			
	Detox reduces oxidative stress			
	Redox			
PECR	Oxidation-reduction process lipid synthesis regeneration cell growth			
GALM	Glucose metabolic process			
	Macrophages			
APOL6	Monocyte to macrophage differentiation lipid metabolism			
TIMD4	Expressed by macrophage maintains killer T cell activity			
CCL18	Attracts T cells to macrophages cellular response to IFNG			
CXCL10	secreted by macrophage in response to IFNG role in hypertension Immune response			
CCL3	Macrophage inflammatory protein cellular response to IFNG			
PRXL2A	Inhibits production of inflammatory cytokines by macrophages			
S100A12	paralog of S100A8 IL-10 induced monocytes macrophages			
PLAC8	Proinflammatory mast cell chemoattractant innate immune response			
PLAC8	Expressed by macrophage phospholipid metabolic process			
ISG15	Regulation of IFNG production Mito function in macrophages			
CCL7	Regulates macrophages attracts monocytes eosinophils but not neutrophils cellular response to interferon-gamma			
	Innate immunity			
CLEC4F	Endocytosis pathogen detector			

Legend: ● down (green), ● neutral (grey), ● up (red)

Comparisons: MARV vs Uninf, EBOV vs Uninf, MARV vs EBOV

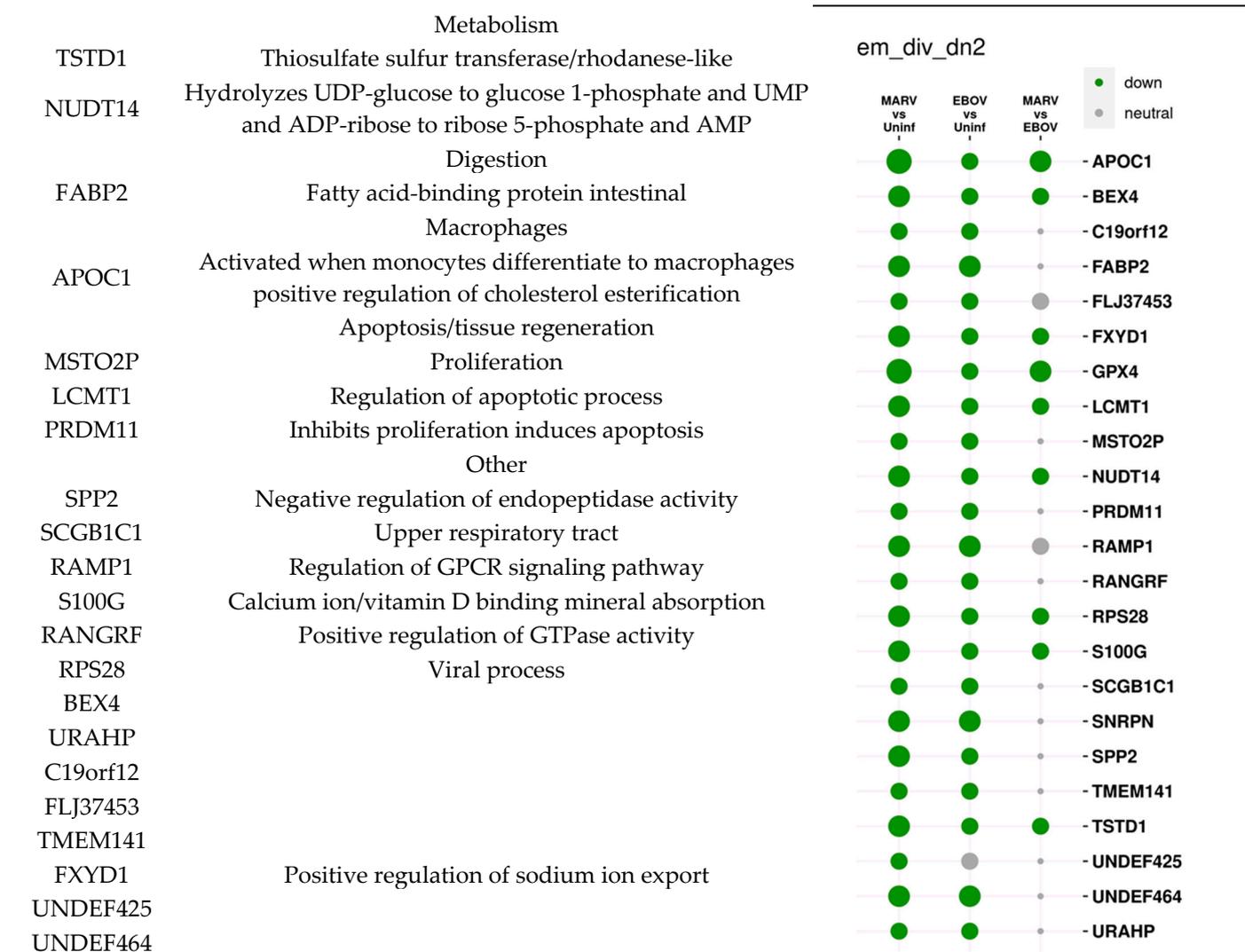
Gene list (from top to bottom): AK3, APOL6, CCL18, CCL3, CCL7, CEBPZOS, CLEC4F, CLECL1, CXCL10, CXCL3, GALM, GLRX, GSTZ1, HAMP, ISG15, MRPL50, PECR, PLAC8, PRXL2A, S100A12, SRGN, TIMD4

Gene	Process	em_div_up2		
		MARV vs Uninf	EBOV vs Uninf	MARV vs EBOV
CLECL1	Expressed by dendritic and B cells enhances IL-4 production regulates immune response			
CXCL3	Chemoattractant for neutrophils immune response			
LY6E	T cell development negative regulator of monocytes dampens response Complement			
MBL2	Activates complement mannose-binding innate immune response Digestion			
PRB1	Digestion salivary proline-rich protein Toxins			
UGT2A3	Excretion of toxic compounds flavonoid biosynthetic process Inflammation			
ORM2	Acute phase reactant regulation of immune system process			
IL1RN	IL-1R antagonist inhibits IL1A/B, modulates inflammation immune response			
MGST2	Generates LTC4 mediates stress			
S100A8	Leukocyte migration involved in inflammatory response Tissue regeneration			
ACOT13	Essential for cell proliferation mitochondrial function (macrophage M2)			
S100P	Cell proliferation, response to organic substance			
NUDT16	Positive regulation of cell proliferation			
EIF4EBP3	Negative regulation of translational initiation Other			
ZG16B	Atherosclerosis retina homeostasis			
SUB1	Regulation of transcription from RNA polymerase II promoter			
UNDEF108				
UNDEF771				

The balloon plot on the right compares responses of genes to MARV-, EBOV-infected and uninfected samples against each other. The radius of circle is proportional to $\log_2(\text{ratio})$, red is for positive, green is for negative values and gray is used when absolute values of $\log_2(\text{ratio}) < 0.6$.

Table S4. Divergent pathways and genes downregulated by MARV and EBOV infection: mitochondrial activity, vascular function, inflammation, innate immunity, lipids, toxins, macrophage activation, splicing, T cell activity, metabolism, digestion, macrophages and apoptosis.

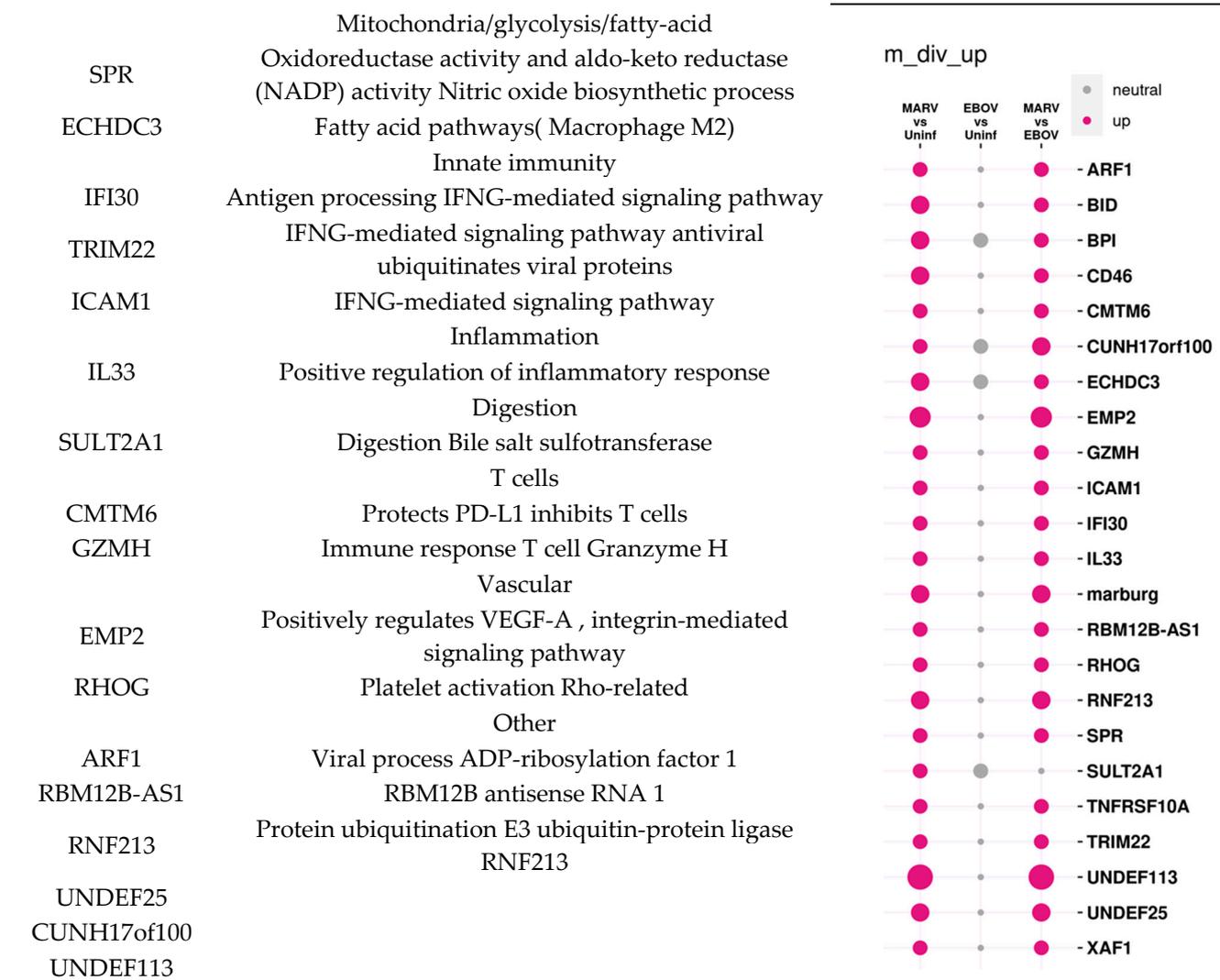
Gene	Process	em_div_dn1		
	Mitochondria/oxidation/fatty-acid			
MRPL54	Organelle organization			
CA3	Nitrogen metabolism bicarbonate transport			
RNASEH1	mtDNA replication mutations lead to autoimmunity(T1D)			
CHCHD7	Protein import			
CHCHD10	Negative regulation of ATP citrate synthase activity			
	Vascular			
ART4	Blood group antigens protein ADP-ribosylation	●	●	●
HRG	Platelet degranulation Histidine-rich glycoprotein	●	●	●
MEG3	Negative regulation of VEGF receptor signaling pathway	●	●	●
TMEM80	Increased transferrin (TF) endocytosis	●	●	●
	Inflammation			
AHSG	Regulation of inflammatory response	●	●	●
CRELD2	ER-stress response	●	●	●
TEX264	Stress , elevated platelet cytosolic Ca2+ responsive	●	●	●
	Innate immunity			
BTBD6	Class I MHC-mediated antigen processing/presentation	●	●	●
C8G	Complement Complement component C8 gamma chain	●	●	●
EEF1D	Positive regulation of I-kB kinase/NF-kB signaling	●	●	●
MIIP	Down-regulates NFKB2 and ICAM1 inhibition of migration/invasion	●	●	●
TMEM80	Increased vaccinia virus (VACV) infection Decreased NF-kB reporter expression	●	●	●
CRIP1	Cysteine-rich protein 1	●	●	●
	Lipids			
MOGAT1	Triacylglycerol biosynthesis and Metabolism	●	●	●
	Toxin			
GSTA5	Detoxification glutathione metabolic process	●	●	●
SLC17A2	Sodium/anion cotransporter family ossification	●	●	●
	Macrophages			
RNASET2	Chemoattractants for macrophages and modulate the inflammatory processes	●	●	●
	Vascular (iron)			
ATP6V0D2	Cellular iron ion homeostasis	●	●	●
BSG	Carries OK antigens on red blood cells:cell surface receptor Signaling pathway:inflammation	●	●	●
LCN2	Sequesters iron (antibacterial) iron/toxin transport cisplatin resistance innate immune response	●	●	●
	Splicing			
SNRPN	mRNA splicing via spliceosome			
	T cell			
GPX4	Role in primary T-cell response to viral infection protects T-cells from ferroptosis supports T-cell expansion mitochondrial			

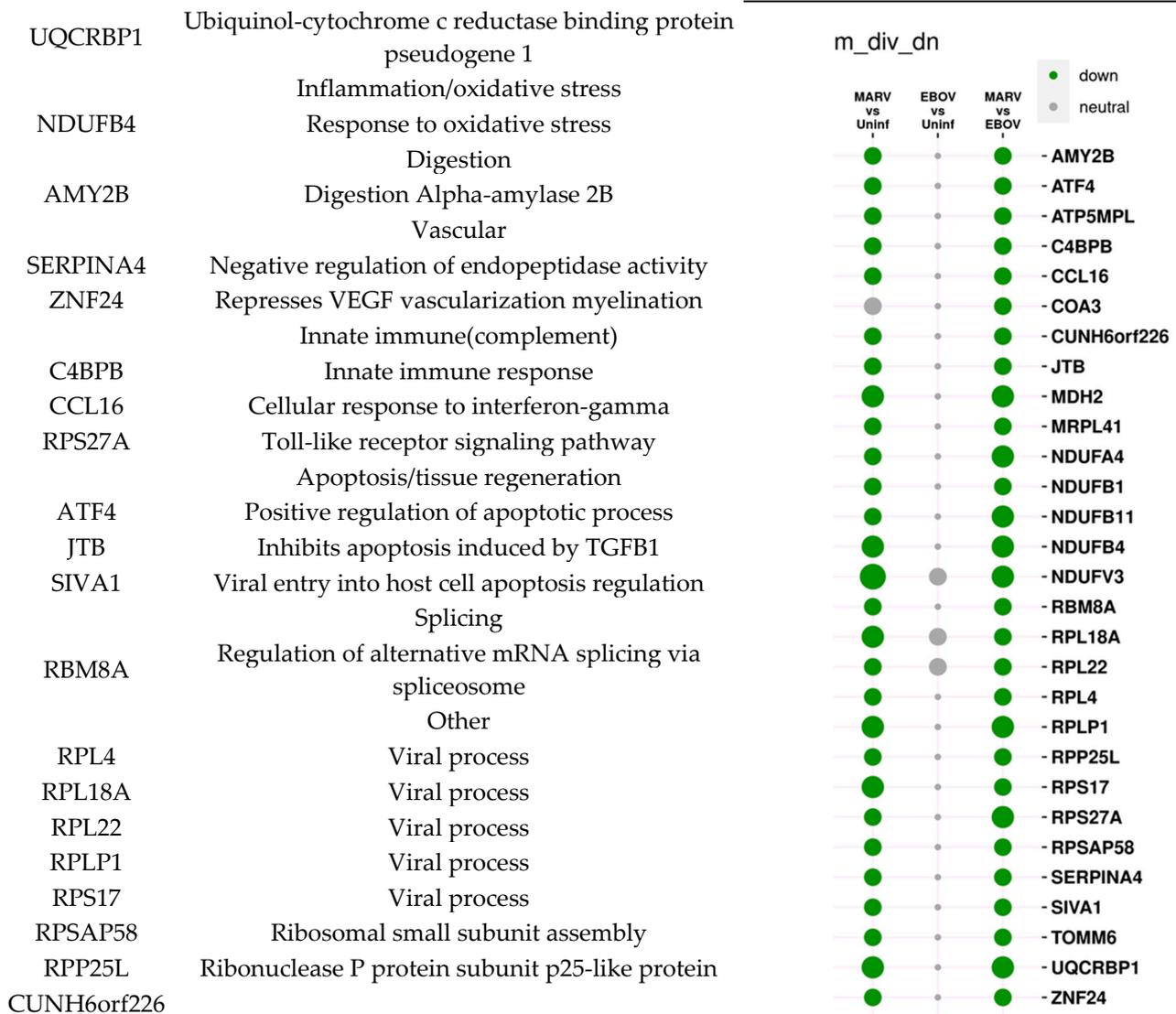


The balloon plot compares responses of genes to MARV-, EBOV- infected and uninfected samples against each other. The radius of circle is proportional to \log_2 (ratio), red is for positive, green is for negative values and gray is used when absolute values of \log_2 (ratio) < 0.6.

Table S5. Divergent pathways and genes upregulated by MARV but not EBOV infection: macrophages, complement, apoptosis, mitochondrial respiration, innate immunity, inflammation, digestion, T cells and the vascular system.

Gene	Process
	Macrophages
BPI	Negative regulation of IL-6 production expressed by Macrophages Bactericidal permeability-increasing protein
	Complement
CD46	Inactivates C3b and C4b protect host cell from damage by Complement innate immune response
	Apoptosis
XAF1	Response to interferon-beta proapoptotic
TNFRSF10A	Activation of NF-kB-inducing kinase activity cell apoptosis
BID	Positive regulation of apoptotic process





The balloon plot at the right compares responses of genes to MARV-, EBOV-infected and uninfected samples against each other. The radius of circle is proportional to log₂ (ratio), red is for positive, green is for negative values and gray is used when absolute values of log₂ (ratio) < 0.6.

Table S7. Divergent pathways and genes upregulated by EBOV but not MARV infection: vascular function, inflammation, mitochondria, lipid metabolism, tissue regeneration.

Gene	Process	
	Vascular	
CYP11B2	Regulation of blood volume by renal aldosterone	<p>e_div_up</p> <ul style="list-style-type: none"> ● down ● neutral ● up
TMEM133/ARHGAP42	Cytochrome P450 11B2 mitochondrial Inhibits RhoA activity to regulate vascular tone and control blood pressure	
CYP11B1	Inflammation/stress Cortisol production stress response Immune response Cytochrome P450 11B1 mitochondrial	
MRPS33	Mitochondrial Translation 28S ribosomal protein S33	
PET100	Respiratory chain complex IV	
NDUFA5	Respiration electron transport NADH to Ubiquinone	
ADIRF	Lipid/fatty-acid Lipid metabolism	
H19	Tissue regeneration	
CENPW	lincRNA cell growth control	
LINC00467	Mitotic cell cycle	
UNDEF312	Other lincRNA 467	

The balloon plot at the right compares responses of genes to MARV-, EBOV-infected and uninfected samples against each other. The radius of circle is proportional to $\log_2(\text{ratio})$, red is for positive, green is for negative values and gray is used when absolute values of $\log_2(\text{ratio}) < 0.6$.

Table S8. Divergent pathways and genes downregulated by EBOV but not MARV infection: innate immunity, coagulation and digestion.

Gene	Process	
BST2	Innate immunity Response to IFNG	<p>e_div_dn</p> <ul style="list-style-type: none"> ● down ● neutral ● up
SERPINA13P	Vascular Protease inhibitor clotting	
SLC51B	Digestion Bile secretion	
UNDEF767	Other	

The balloon plot at the right compares responses of genes to MARV-, EBOV-infected and uninfected samples against each other. The radius of circle is proportional to $\log_2(\text{ratio})$, red is for positive, green is for negative values and gray is used when absolute values of $\log_2(\text{ratio}) < 0.6$.

Table S9. Correlations between various samples based on expression levels of genes.

cb1 versus cb2 and cb3. Sample cb1 is dissimilar to cb2 and cb3							
This study	cb2_Uninf	cb3_Uninf		ALL	cb2_Uninf	cb3_Uninf	
cb1_Uninf	0.77	0.74		cb1_Uninf	0.73	0.77	
cb2 and cb3 are consistent with each other.							
This study	cb2_Uninf	cb3_Uninf		ALL	cb2_Uninf	cb3_Uninf	
cb2_Uninf	1	0.94		cb2_Uninf	1	0.91	
cb3_Uninf	0.94	1		cb3_Uninf	0.91	1	
Uninf versus MARV. cb1 is similar to MARV while cb2 and cb3 are not							
This study	ab06_mb	ab07_mb	ab08_mb	ALL	ab06_mb	ab07_mb	ab08_mb
cb1_Uninf	0.74	0.86	0.71	cb1_Uninf	0.66	0.8	0.61
cb2_Uninf	0.26	0.46	0.24	cb2_Uninf	0.31	0.5	0.27
cb3_Uninf	0.39	0.56	0.37	cb3_Uninf	0.42	0.6	0.37
Uninf versus EBOV. cb2/3 are similar to EBOV while cb1 is not							
This study	ab01_eb	ab02_eb	ab03_eb	ALL	ab01_eb	ab02_eb	ab03_eb
cb1_Uninf	0.81	0.86	0.69	cb1_Uninf	0.82	0.85	0.58
cb2_Uninf	0.92	0.88	0.89	cb2_Uninf	0.88	0.86	0.75
cb3_Uninf	0.99	0.96	0.98	cb3_Uninf	0.96	0.93	0.79
MARV versus MARV. The MARV samples are consistent with each other							
This study	ab06_mb	ab07_mb	ab08_mb	ALL	ab06_mb	ab07_mb	ab08_mb
ab06_mb	1	0.97	1	ab06_mb	1	0.96	1
ab07_mb	0.97	1	0.96	ab07_mb	0.96	1	0.94
ab08_mb	1	0.96	1	ab08_mb	1	0.94	1
EBOV versus MARV. The correlations between MARV and EBOV samples are low							
This study	ab06_mb	ab07_mb	ab08_mb	ALL	ab06_mb	ab07_mb	ab08_mb
ab01_eb	0.47	0.64	0.45	ab01_eb	0.5	0.68	0.45
ab02_eb	0.6	0.75	0.58	ab02_eb	0.59	0.76	0.55
ab03_eb	0.38	0.54	0.36	ab03_eb	0.35	0.49	0.33
EBOV versus EBOV. The EBOV samples are consistent with each other							
This study	ab01_eb	ab02_eb	ab03_eb	ALL	ab01_eb	ab02_eb	ab03_eb
ab01_eb	1	0.99	0.96	ab01_eb	1	0.96	0.78
ab02_eb	0.99	1	0.94	ab02_eb	0.96	1	0.84
ab03_eb	0.96	0.94	1	ab03_eb	0.78	0.84	1

In each sub-table, on the left are the correlations between samples considering only the genes used in this study and on the right are correlations calculated using all the genes detected by mRNAseq. These are consistent with the hypothesis that MARV infection of ERBs elicits a strong reaction, while EBOV infection is more muted and similar to the uninfected samples. cb1 shows hallmarks of inflammation, justifying its exclusion from the study (also seen in Fig 3). Uninf = uninfected, mb = MARV-infected, eb = EBOV-infected. Sample names start with cb, or ab followed by numbers.