

FAST ASCEND OF BASALTIC MAGMAS FROM 7600 BP ERUPTION OF SHIVELUCH

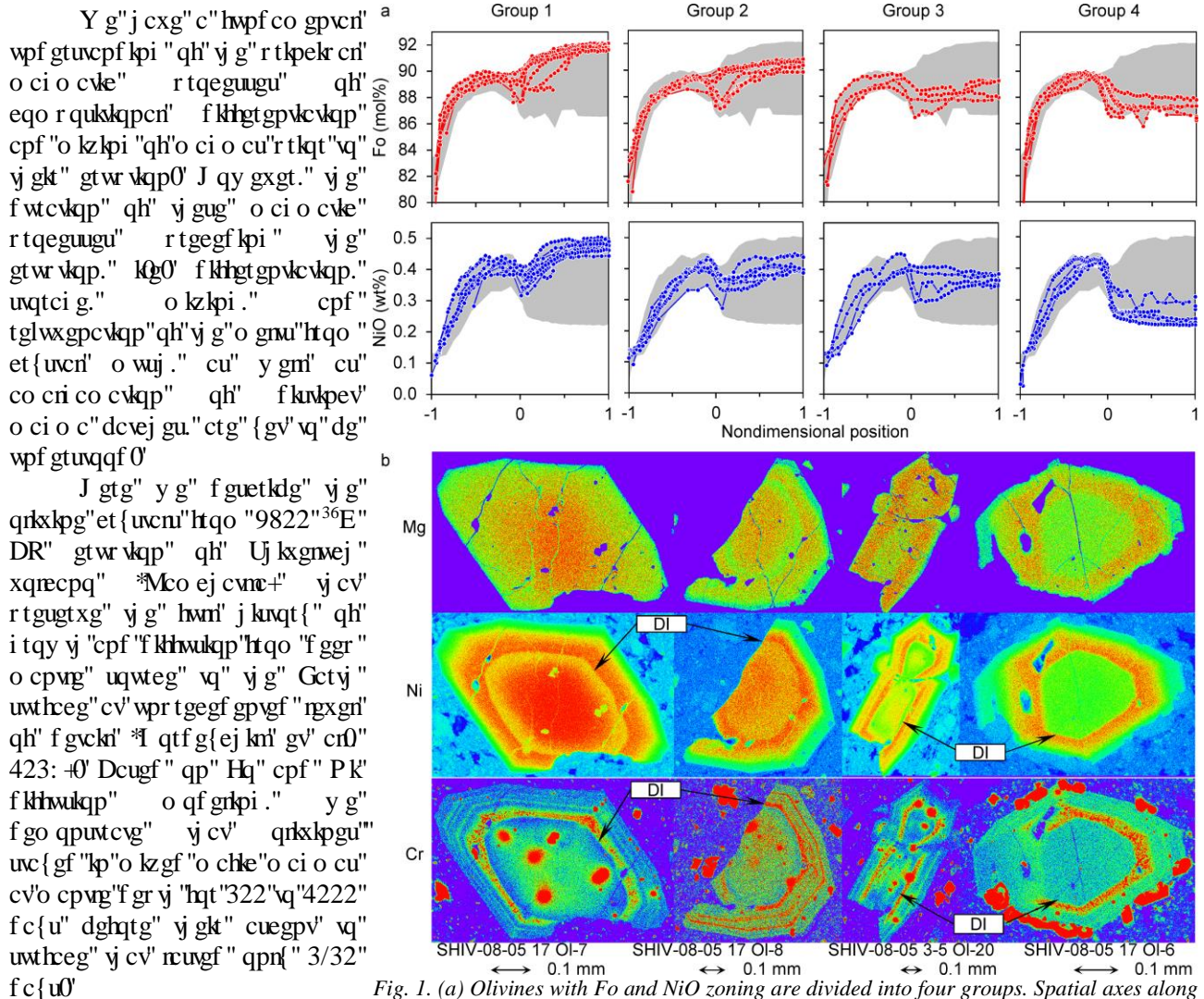
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Fig. 1. (a) Olivines with Fo and NiO zoning are divided into four groups. Spatial axes along the profiles are in dimensionless coordinates: "0" corresponds to the location of the resorption interface, "-1" to the margin of the crystal, and "1" to centre of the crystal. Gray fields show all data for reference. The shapes of gradients in the cores change from bell-shaped to flat from group 1 to 4. (b) Representative compositional maps of crystals for four different groups of cores for elements of different diffusivities. The spectrum of colors from red to violet corresponds from maximum to minimum element concentrations. Note the smooth compositional variations for Fe-Mg. Ni shows more structure and clearly outlines the dissolution interface (DI) between outer core and mantle of the crystals. Cr is an element with slow diffusivity and shows a dissolution interface (DI) between the core and the mantle more clearly than Fe, Mg, and Ni. Cr also has retained delicate oscillatory growth zoning in the crystal mantle. The high-chromium inclusions in olivine is chromite.

cpf "PK" f kwt kdwkqpu" utqpi n' eqpvtcu' y kj " i tqwr " 6" eqtgu. y j lej " j cxg" nqy " cpf " gpvtgn' hrv'Hq'cpf "PK" f kwt kdwkqpu"lp' y j gk "eqtgu" tqrw u"4"cpf "5"ctg' kpvto gf kcvg. " y j gk " eqtgu" ctg' i gwkp' " i tcf wcm' " nqy gt " lp' Hq' cpf "PK"cpf "y j gk "f kwt kdwkqpu" dgeqo g'kpetgculpi n' hrv'0'

Vj ku' ergetn' " kpf kcvgu' y cv*3+eqtgu'cpf "o cpvgu'y gtg' hqto gf " d{ " f kwt kdwkqpu" f kwt gpv' v{r gu'qh'r tqeguugu'cpf "4+chgt' f kwt kdwkqpu" cm' et {ucnu' y gtg' ko o gtugf " lp' " cpf " i tgy " htqo. " y j g'uco g'pgy "cpf "kpetgculpi n' f kwt gpv'kcvg' " o ci o c0' Y j krg' Hq' cpf " PK" ctg' fgetgculpi " uo qqy n' " lp' y j g' o cpvrg. " cm' unqy gt "f kwt kdwkqpu" grgo gpw' *Ec. " Et. " Cn' R+ uj qy " uj ctr" cpf " quekrcvt { " qplpi " r cwgtpu' Hki 0' 3d. "4+0'

Qrkxkpg' i tqy yj " cpf " f kwt kdwkqpu" j kwt { " ctg' uej go cvecm' "uj qy p"lp' Hki 0'5" cpf "f guetkdgf "dgrqy <

30' Qrkxkpg' eqtgu' *Hq. 4' cpf " PKQc207" y v0' " + " y gtg' hqto gf " htqo " c" j ki j /O i " cpf " j ki j /PK' o gn'cpf "kpkkcm' "j cf "c" wplkqto "Hq'cpf "PK" f kwt kdwkqpu" *Hki 0'5c+0'

40' Vj g'g' qrkxkpg' et {ucnu' gpeqwpvgtgf " c" o qtg' gxqrgf " o gn' vq " y j lej " y j g' kpvtej cpi gf " d{ " f kwt kdwkqpu" vqy ctfu' gs wkdtdkwo " cv' Hq. 8.6" cpf "PKQc204"y v0' " *Hki 0'5d+0' Qrkxkpg' et {ucnu' y j gtg' y j g' f kwt kdwkqpu" r tqegu' f k' "pqv'tgcej " y j g' kppgt' eqtgu' *i tqwr " 3+ kpf kcvg' f kwt kdwkqpu" ko gu'tcpi kpi " htqo " 622" vq " 3: 22" f c{ u0' Vj g' kppgt' eqtgu' qh' qrkxkpgu' htqo " i tqwr u"4"cpf "5"y gtg' chhgevgf " d{ "f kwt kdwkqpu" vq "xctkcdng' f gi tggu' y kj " f kwt kdwkqpu" vko g' tcpi kpi " htqo " 322" vq " 4222" f c{ u0' Qrkxkpgu' htqo " 6" i tqwr " eqo r rvgv' " gs wkdtdcvgf " y kj " y j ku'gxqrgf "o gn0'

50' Vj g'pgzv'gxgpv'lp' y j g' j kwt { "qh'y g'g' qrkxkpg' et {ucnu' y cu'o ci o c' o kzkpi "y kj "c"pgy " erased Mg and Fe and, less so, Ni and Ca zoning patterns."

j ki j /O i "cpf "j ki j /PK' o gn'F w'vq "y j g' j ki j "go r gtcwtg'qh'y ku' o gn' "y j g' tko u'qh' qrkxkpg' eqtgu' y gtg' r ctv' " f kwt kdwkqpu" et gcvpi "c' r tqo kpgpv'tguqr vq'p'kv'gthcrg'dgy ggp'eqtgu'cpf "o cpvrg' *Hki 0'5e+0'

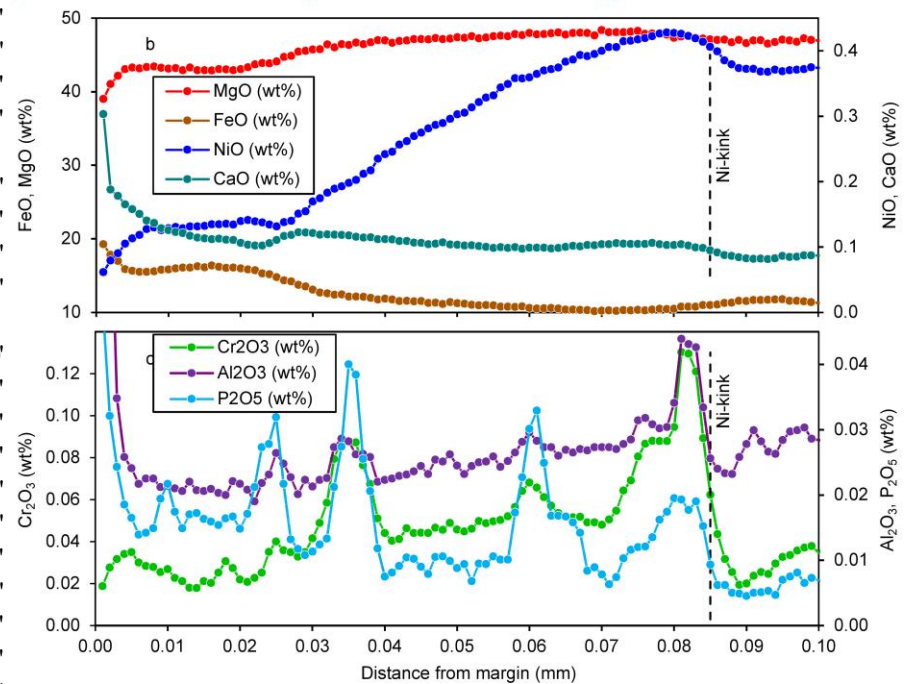
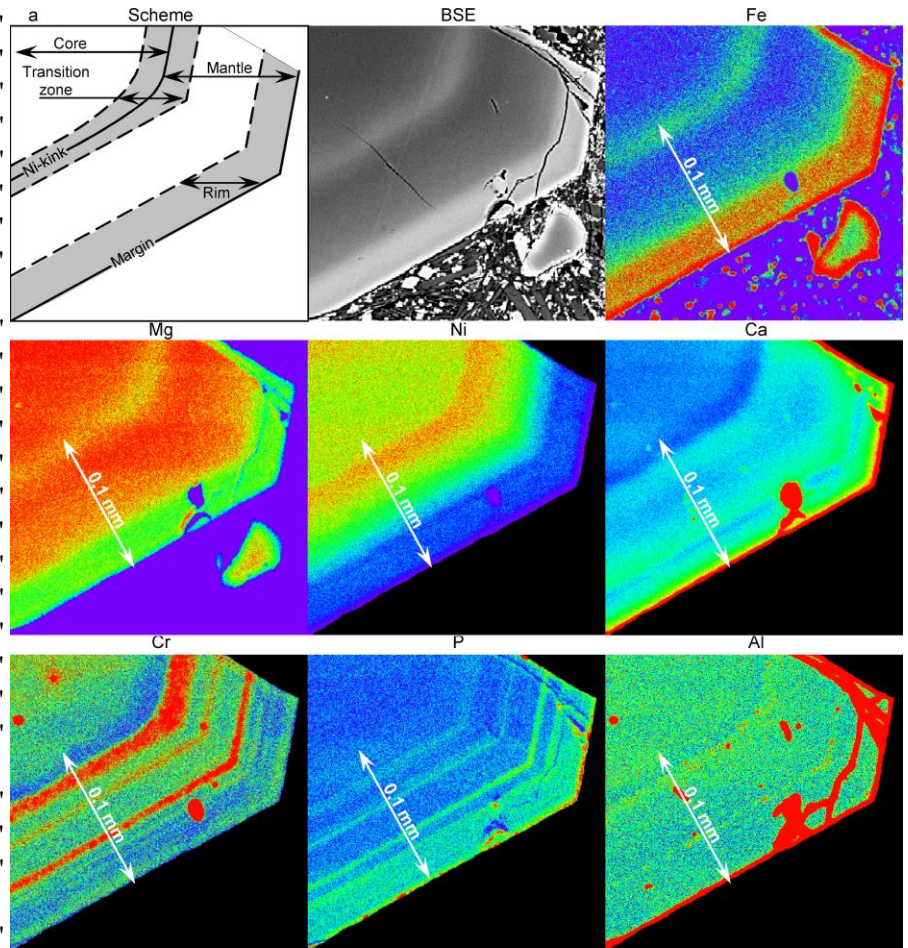


Fig. 2. (a) – Fe-, Mg-, Ni-, Ca-, Cr-, Al-, and P-element distribution maps in the olivine crystal with growth zones. Here we show only a small part of crystal SHIV-08-05 17 Ol-8. The spectrum of colors from red to violet corresponds from maximum to minimum element concentrations. (b, c) detailed profile with steps of 0.001 mm, marked by white arrows on (a), shows the variable width of the high-concentration zones, which depend on their relative diffusivities ($P < Al < Cr < Ca < Fe < Mg$). This clearly indicates that the mantles of the olivines were initially zoned on all these elements but subsequent diffusion has partially

60' Uwdugs wgpv' eqqrkpi " tguwmu" kp" pgy " j ki j /Hq" cpf " j ki j /P'K' qrkxkpg" i tqy vj u" qxgt" tguqtr vkp"lpvgt hceg"vj cv'htqto gf " vj g'o cpvrg"qh'vj g"et {ucnu" *Hki 0' 5f+0' Vj ku" lpvgt hceg" y cu" o qf kkgf "d { "rcvgt "f khwukqp"vj cv' uo qqvj gf " vj g" kpkken' f kwtldwkqpu"qh'vj g"Hq"cpf "P kQ" cetquu" c"tcpukskqp"l qpgo' 70' P gy n' " i tqy p" qrkxkpg" kp" vj ku" | qpqg" ku" gptlej gf " kp" Et4Q5" wr " vq" 206/206" y x0' " . y j lej " kp" uqo g" i tckpu" ku" ceeqo r cplgf " d { " xctkcvkqpu" kp" Cn' cpf kqt " R0' Uwdugs wgpv' et {ucnk' cvkqp" uj qy u" f getgculpi " hqtugtkg" f qy p" vq" Hq:2" vqy ctf u" vj g" tko u" qh' et {ucnu" cpf " eqpegpvtke." quekncvqt { " cpf " eqttgrcvgf " Et/ Cn/R'i tqy vj "dcpf u" *Hki 04+0' 80' Y j kxg" Et. " Cn" cpf " R" uj qy "uj ctr "i tqy vj "dcpf u"kp"vj g" o cpvrg. " Hq. " P kQ" cpf " rguu" uq" EcQ" xctkcvkqpu" ctg" uo qqvj gf " qw" d { " f khwukqp" f wtkpi " vj g" uco g" vko g" kp" y j lej " f khwukqp" o qf kkgf " vj g" tguqtr vkp" lpvgt hceg" *Hki 0' 5g+0' Vj g" f wtkcvkqp" qh' vj ku" rcuv' *i tqy vj /" cpf +f khwukqp"uci g"ku"qpnr { "3/ 32" f c { u0' Vj ku" uwi i guw" c" xgt { " uj qtv' vko g" dgvy ggp" vj g" rcuv' tgej cti g" gxgpv' cpf " uwthceg" gtwr vkp0'

Vj g'i tqy vj "cpf "f khwukqp" f qewo gpvfg" j gtg" qeewtfg" kp" f qewo gpvfg" j gtg" qeewtfg" kp" vj g" j ki j /O i " j ki j /P'K' eqtgu"cpf " vj g" j ki j /O i " j ki j /P'K' o cpvrgu" qh' qrkxkpgu" y gtg" hqto gf " chgt" vj g" rcuv' o kzkpi " gxgpv' Vj g" eqo r qukskqp" qh' vj g" tgej cti kpi " o gn' j cu" O i %2 86/87. " kq0' ku" kp" gs wkdtdkwo " y kj " c" r tko ct { " o cpvrg/ f gtxgf " o gn0' Vj gug" hcevtu" vqi gyj gt" y kj " f gr vj u" 3: /52" no " htqo " R/V/fQ4" eqpf kskqpu" qh' qrkxkpg" et {ucnk' cvkqp" ko r n' " vj cv' o kzkpi " dgvy ggp" f kwpkv" o gn' eqo r qukskqpu" cu" tgeqtf gf " kp" vj g" qrkxkpg" et {ucnu" o wuv' j cxg" vcnpg" r nceg" cv' o cpvrg" f gr vj u0' Vj gtghqtg. " vj g" hqto cvkqp" qh' vj g" eqtgu. " vj gk" uqtcig" cpf " o kzkpi " kp" vj g" o cpvrg" qeewtfg " f wtkpi " 322" vq" 4222" f c { u' dghqtg" gtwr vkp0' J qy gxgt. " vj g" vko g" chgt" rcuv' o kzkpi " cpf " vj g" y c { " htqo " vj g" o cpvrg" uqwtg" vq" vj g" uwthceg" j cr r gpfg " y kj kp" qpnr { " 3" vq" 32" f c { u0'

Qw" tguqtej " uj qy u" vj cv' et {ucnu" i tqy vj . " o kzkpi " cpf " f khwukqp" r tgeguugu" qp" vj g" y c { " htqo " o cpvrg" uqwtg" vq" uwthceg" o c { " dg" s wkg" eqo r rgz" cpf " vko g" qh' cuegpv' htqo " o cpvrg" uqwtg" vq" vj g" uwthceg" ecp" dg" xgt { " hcu' o' l wuv' hgy " f c { u' dghqtg" vj g" gtwr vkp0' o' ko r n' kpi " cuegpv' tcvgu" qh' : 2" vq" 3422" o' lj 0' Tguqtej " y cu' uwr r qtvfg " d { " i tcpuw' I UHY q" 584173/3. " THDT" 38/77/34262. " cpf " THDT" 39/77/722270' "

Tghgtgpegu"

Tghgtgpegu"

I qtf g { ej km" D0" Ej wtknqxc. " V0" Mtqpl . " C0" Uwpf gto g { gt. " E0" Uko cnkp. " C0" Y 3/4pgt. " I 0" *423: + " I tqy vj " cpf " f khwukqp" kp" qrkxkpg" kp" wntc/ hcu' cuegpv' kpi " dcucn' o ci o cu' htqo " Uj kxgrvej " xqrecpq" l' l' Uek0T gr 0" *k' t' gx00'

kpwkwg" qh' Xqrecpqm { " cpf " Ugluo qm { " HGD" TCU. " Rgtqr cxnqxum/ Mco ej cvunf . " Twukc. " 42y /48y " Cwi wuv. " 423: "

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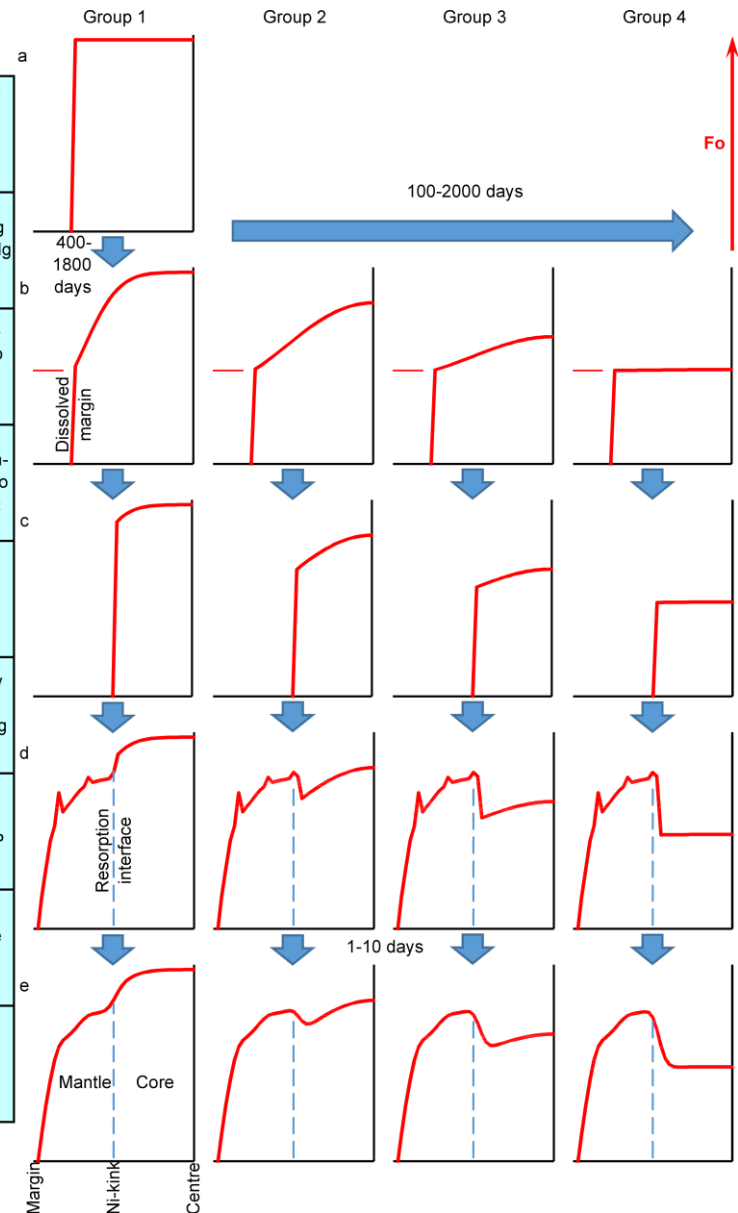


Fig. 3. The schematic evolution of the growth, dissolution and diffusion of olivine crystals is depicted in core to margin Fo-profiles. (a) The high-Mg olivines with a flat Fo-distribution were formed first. (b) Once in a low-Mg melt, olivines were affected by diffusion to a different extent. (c) Recharge with a hot high-Mg melt dissolved outer parts of zoned olivines. (d) High Mg mantles grew over the resorbed cores of different type. (e) Finally, diffusion across the resorption interface and across the mantle growth zone started. The resulting Fo-profiles are similar to the measured profiles in Fig. 1."