

The behavior of volatile components (S, F, Cl) in dacitic magma of a large caldera eruption of the Vetrovoy Isthmus (Southern Kuriles) according to the results of the study of apatites

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³P qxqukdktumUcvg'Wpksgtukv{. "P qxqukdktum'Twuukc"

⁴XUQUdqdrxg'Kpukswg'qh'I gqrqi { "cpf "O kpgtcrqi { "UD"TCU."P qxqukdktum'Twuukc"

Vj g"qdlgev'qh'uwwf { "qh'y ku'y qtm'ku" c"rti g"ecvutqr j le"gtw vqp"cr r tqzko cvgn { "322"no ⁵+ "qh'y g" Xgtqxq { "Kvj o wu"XK: qeewtgf "5: 722"O'722"y qwucpf { { gctu"ci qO'Vj g"gtw vqp"qeewtgf "lp"y g"r nceg'qh" c" uj cmqy "utck: "y j lej "ugr ctcvgf "y g"pqt y gcuqtp "cpf "egpvcn'r ctu'qh'y g'o qf gtp "kucpf "qh'Kwtw "Dwi cmqy. "3; ; 6=I qtuj nqx. "3; 89+0'K'ku"cuwo gf "y cv'y g"gtw vkg'egpvt "ku'qecvgf "cr r tqzko cvgn { "lp"y g'o kf f ng'qh'y g" kvj o wu=r { tqercuk "f gr quku"ctg"y g'r tqf wev'qh'qpg"qh'y g"rti guv'gtw vqp"qt "ugt'ku'qh'pgct/uko wncpgqwu" gtw vqp"lp"y g"Mt'kg/Mco ej cvnc'cte"lp"y g"rcv'Rgkueqpgg. "y g"Gctn { "J qnqegp'O'Utwewtcmf. "y g"XKku" c" i tcdgp"cdqw"34"no "y kf g. "hkgf "y kj "r wo leg/r { tqercuk "f gr quku"y kj "c"ecr cek { "qh'o qtg"y cp"482"o gvguO' Cu"ku"npqy p. "uwej "gtw vqp"ctg"cuqekvgf "y kj "hkek'qh'hgnke"o ci o cu"y kj "c"rti g"eqpvgp'qh'xqrcvkg" eqo r qpgpw"J 4Q. "EQ4. "H"En"U. "gve0'0'Vj g'f qo kpcpv'xqrcvkgu"ctg"y cvgt"cpf "ectdqp"fkqzkg. "y j lej "rti gn { "f gvgto kpg"y g"gxqnwkp"qh'y g"uqteg. "y g"rtqeguug"cpf "eqpf kkp"qh'f gi cuukpi "cpf "et { ucnk kkp"qh' o ci o cOJ qy gxt. "eqo r qpgpw"uwej "cu'uwht. "hwtkpg"cpf "ej ntkpg"cuq"r r { "cp"ko r qtcvp'tqng"lp"tgwqt kpi "y g"uci gu'qh'y g"gxqnwkp"qh'y g"o ci o cO'Vj g"uwwf { "qh'cr cvkg"cu'y g"o ckp"o kpgtcn'eqpvgp'ctq"qh'xqrcvkg" grgo gpw'ecp"i kxg"ko r qtcvp'kphqto cvkp"cdqw"y g"fkukdwkp"qh'o qdkg"eqo r qpgpw'dgy ggp"hwk. "o gn" cpf "et { ucnk kpi "o kpgtcnO'

Vj g"tqemu'qh'y g"Xgtqxq { "Kvj o wu"ctg"tgrtgugpvgf "d { "whhu"y kj "htci o gpw'qh'rti j v'r wo legO'Vj g" r qtquk { "qh'r wo leg'ku"62/87" O'Vj g'f gi tgg'qh'et { ucnk kkp"qh'y g'o gn'lp"fkhtgpv'uco r ngu'xct'ku'y kj lp'y g" tcpi g"qh'44/54" OI rcuu'qh'y g"i tqwpf o cuu"cpf "o gn'kpenwkp"O K'lp"cm'o kpgtcn'eqttgur qpf u"vq"tj { qkkg" *UQ4"95/98"y vO" +0'Vj g'r j gpqet { uuu"ctg"tgrtgugpvgf "d { "r rci kqercug. "s wctv. "cvi kg. "j { r gtuy gpg"cpf "Hg/VK" qzkg guO'Rwo leg"XKku"ej ctcevtk gf "d { "y g"cdugpeg"qh'r j gpqet { uuu'qh'co r j kdrq. "y j kg"kv'qeewtu"lp"y g'hqto " qh'et { ucnkpg"kpenwkp"lp"r { tqzpggu. "j cu'c"j k j "cnwo kpc"eqo r qukkp"cpf "ku'r tqdcdn { "c'tgukg'qh'o gnkpi "qh' y g'o gvcducg"uudutcvgO'Rrci kqercug. "r { tqzpggu. "Hg/VK"qzkg gu"cpf "cr cvkg'tgrtgugp'v'y g"ctn { "r ctcu gpguk"qh' r wo leg. "y j kg"lwu'dghqtg"y g"gtw vqp"y g'hqto cvkp"qh'f ctm'eqrtgf "o kpgtcn'ecugf. "cpf "qpn { "r rci kqercug" cpf "s wctv { "et { ucnk gf "htqo "y g'o gnO' Cp"ko r qtcvp'hgcwtg"qh'r rci kqercug"ku'y cv'ku'et { ucnk kkp"dgi kpu" y kj "o gf kwo "eqo r qukkp" Cp"67/77+ "y gp"y g'ecrkwo "eqpvgp'kpetgcugu"vq"y g'o czko wo "xcnwgu" Cp"; 7+ " cpf "y g"rcvgu" | qpgu"ci ckp"j cxg"cp"cxgtci g"eqo r qukkpO' K' y ku'ecug. "y g"j k j /ecrkwo "r rci kqercug"ku" tgrtgugpvgf "d { "ur qu'lp"y j lej "o gn'cpf "hwk"kpenwkp"eqgzkv. "y j lej "o ctmu'y g'f gi cuukpi "qh'y g'r ctgpv' o ci o c"Uo ktpqx"gv'cnO'4239=O cmko qxlej "gv'cnO'4239+0"

Cr cvkg"ku'pqv'hqwpf "lp"y g'hqto "qh'lpf gr gpf gpv'r j gpqet { uuu. "dw'k'ku'y g'o quv'eqo o qp"et { ucnkpg" kpenwkp"lp"cm'o kpgtcn'qh'XKku'ku'cuq'pqvgf "y cv'c"rti g'r tqr qt'vqp"qh'cr cvkg"kpenwkp"ctg"lp"y g'o kpgtcn' qh'y g"ctn { "uci gu'qh'y g"gxqnwkp"qh'y g'hqewu"r { tqzpggu"cpf "r rci kqercug"eqtg+ "y j kg"lp"y g'rcvgu'o kpgtcn/" s wctv. "kpenwkp"qh'cr cvkg"ctg'tctg" *Hk 03+0'Ceeqt f kpi "vq"y g'o gvj qf "qh'tgecrewvki "y g'ej go lecn'cpn { uku" qh'o gn'kpenwkp"u' d { "y g'pqto cvkg"o kpgtcn'eqo r qukkp" *ERY + "y g'o cuu'htcevkp"qh'cr cvkg"lp"o ci o c'f qgu" pqv'gzegf "2087'y vO" O'O gcuwtgf "d { "y g"UGO "GF U'o gvj qf. "y g'eqepgtcvkp"qh'H'lp"cr cvkg"xct { "htqo "3079" vq"4079'y vO" O'Vj g'eqepgtcvkp"qh'En'o gcuwtgf "d { "y g"Y F U'o gvj qf "xct { "htqo "308; "vq"4086'y vO" O'Vj gug" eqepgtcvkp"u' f gvgto kpg"y g'tcpi g"qh"Z_HZ_{QJ} "tcvku"qh"307/6088. "y kj "o quv'qh'k'hcnkpi "y kj lp"y g'tcpi g"qh" 3.7/4.7=Z_{En}Z_{QJ} "2.8/3.6=Z_HZ_{En} "3.7: /5.55" *Z_H "Z_{En} "Z_{QJ} "o" ctg"y g'o qng"htcevkp"qh'y g'eqttgur qpf kpi " eqo r qpgpw+0'Xctcvkp"lp"y g'eqo r qukkp"qh'xqrcvkgu"lp"cr cvkg"ecp"dg" f guetkdgf "d { "ej cpi kpi "y g"QJ IH" tcvk"cv"cp"cm quv'equpcv'En'eqepgtcvkpO'Cr cvkg"htqo wrcvqp"uj qy "c"r qukkxg"eqttgcvkp"dgvy ggp" tgrvqp"uj k u"Z_{En}Z_{QJ} "cpf "Z_HZ_{QJ} O'F khtgpegu"lp"y g'eqo r qukkp"qh'cr cvkgu. "f gr gpf kpi "qp"y g'r qukkp"qh' y g'uco r ng"lp"y g'ugevkp. "y gtg"pqv'tgxgcrgf O'Cuq. "y gtg"y cu"pq" f khtgpeg"lp"y g'eqo r qukkp"qh'cr cvkg. " f gr gpf kpi "qp"y g'j quv'o kpgtcnO'

Kp"y g"cdugpeg"qh'eqpf kkp"htqo co r j kdrq"htqo cvkp. "J 4Q"cpf "En'cevkgn { "ceewo wrcv"lp"y g'o gn" cpf "hwk O'Xqrcvkg"eqo r qpgpw"uwej "cu'EQ4. "U. "H"cpf "R"j cxg"y g"cdkx { "vq"eqepgtcvg"uudutcvkcm { "lp"y g" et { ucnkpg"r j cug"lp"cf f kkp"vq"y g'o qdkg"r j cuguO'K' y g"ecug"qh'r wo leg"XK"y g"qpn { "o kpgtcn'ecr cdng"qh' eqepgtcvkpi "y gug"grgo gpw'ku'cr cvkgO'K' y ku'r cr gt. "y g'eqo r qukkp"qh'cr cvkgu"ctg" f gvgto kpgf. "cpf "uqo g" r cwgtpu'qh'ej cpi gu'lp"y g'eqo r qukkp"qh'cr cvkg"cpf "y gk'kpvrtgcvkpO"

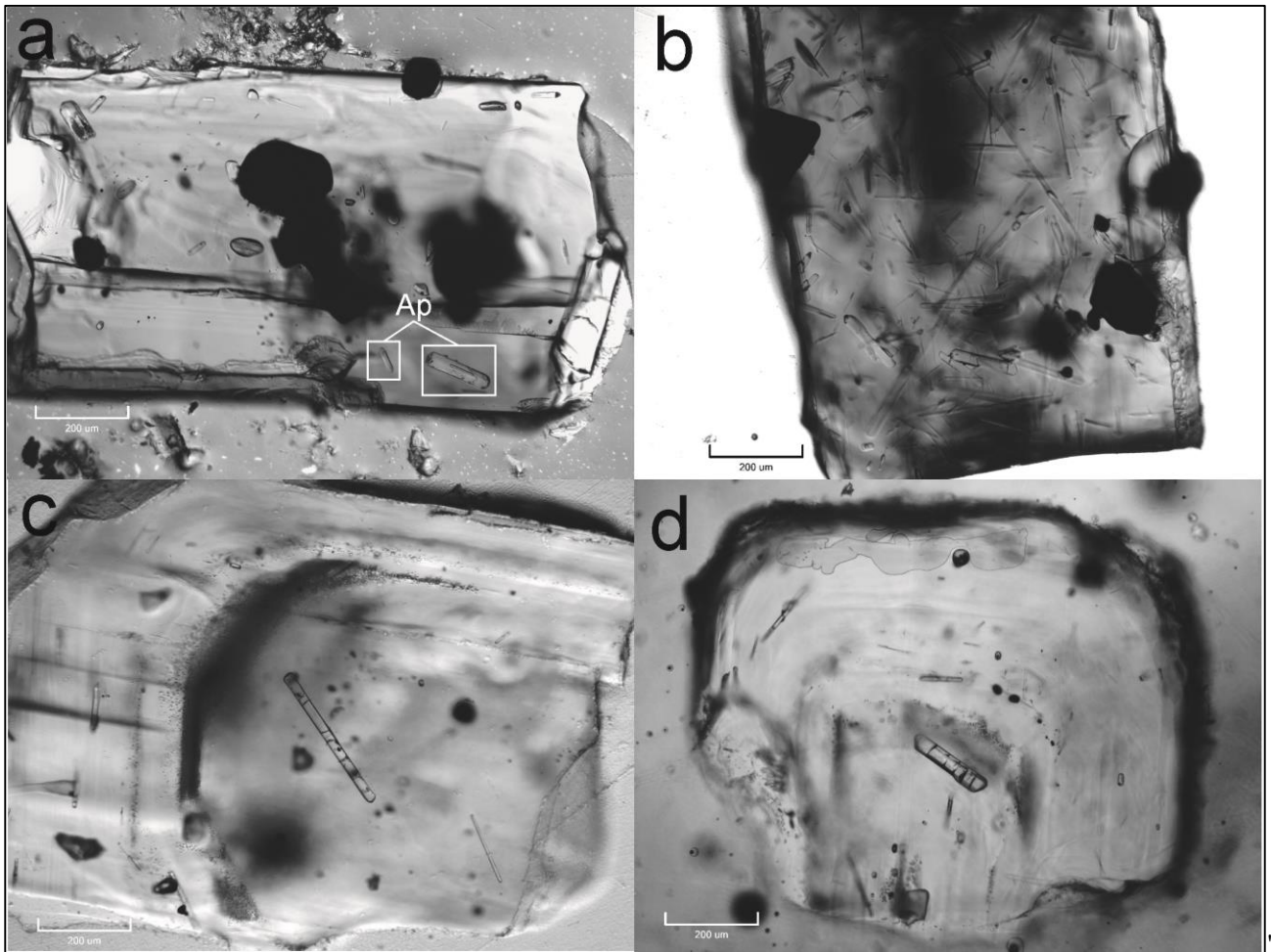


Fig. 1. Crystalline inclusion of apatite (Ap) in (a) Clinopyroxene (Augite); (b) Orthopyroxene (Hypersthene); (c,d) Plagioclase (An 50)

Htqo "gZR gtKo gpvcrly qtni*F qj gt v{ "gv'crn0"4236. "Y gduvgt "gv'crn0"422; . "Y gduvgt "gv'crn0"4239+ "k'ku'npqy p" vj cv'xctkcvkpu"lp"y cvgt. "ej mtkpg. "hwtkpg"cpf "uwhwt"lp"cr cvksg"ctg"r qukkxgn{ "eqttgrcvy"y kj "vj g"eqpvvqv"qh" vj gug"eqo r qpqpvu"lp"vj g'o gn'cpf "hwtk O'C"nti g"pwo dgt "qh"lpenwukpu"qh"cr cvksg"lp"o lpgtcni"qh"vj g"getn{ "uci gu"cpf "eqo r qukkqpu"qh"vj g"cpn{ | gf "cr cvksgu"y gn'knwutcvy"vj g'r tqeguu"qh"ceewo wrcvqp"qh"xqrcvkgu"lp" o ci o c"dgthgt" f gi cuuki O'Vj ku"gzr rcpu"vj g"ur tgc{ "lp"tgrcvqp"vq"Z_{QI} Z_H"y kj "vj g"tgrcvkg"eqpuvce{ "qh" Z_{QI} Z_{En}"cpf "Z_HZ_{En}O'Vj g'lpetgcug"lp"vj g'pwo dgt "qh" { f tqz { nu"lp"vj g'cr cvksg"utwewt g'o ctnu"vj g'ceewo wrcvqp" qh'y cvgt "lp"vj g'o gn'lp"vj g'cdugpeg"qh'hwtk f g"gpvtkpi "vj g'u{ ugo "C_F^M"2027/202; " 0" +0Cv'vj g'uco g'vko g." vj g'ceewo wrcvqp"qh'ej mtkpg"lp"vj g'u{ ugo "f k' "qeev"r qukkdnl "f wq"vq" f geqo r qukkqpu"qh"vj g'co r j kdgng"cpf" f gvgto kpgf "uo cni'xctkcvkpu"lp"vj g'eqpegpvcvqp"lp"cr cvksg"305; /406'y v0" +cpf "O K*2042/2064'y v0" +0

Vj g'o gcuwtgf "uwhwt"eqpvvqv"lp"cr cvksgu"xt{ "y kj lp"vj g"tapi g"qh"202/207'y v0" "UQ₅"cpf "f q"pqv" gzeggf "vj g'f gvgcvqp"rko k'lp"o gn'kpenwukpu"cpf "i tqwpf o cuu'i nuugu" >2043'y v0" "UQ₅+0Vj g'uwhwt"eqpvvqv" lp"cr cvksg. "cu'y gn'cu"qvj gt "o qdkg"eqo r qpqpvu. "r qukkxgn{ "eqttgrcvy"y kj "ej cpi gu"lp"vgo r gtcwtg. "r tguwtg" cpf "lp"vj g'eqpvvqv"qh'uwhwt"lp"vj g'o gn'O'Ceetf kpi "vq"vj g'gzr gtKo gpvu"ecttkgf "qvw"qp"vj g'j qo qi gpk cvkqp"qh" vj g'O K' vj g'vgo r gtcwtg"ur tgc{ "y cu"pqv" qdvcpgf O'Cni'cxckcdng"o gn'kpenwukpu"j cxg" c"j qo qi gpk cvkqp" vgo r gtcwtg"qh": 52/: 82"Å O'Xctkcvkpu"rky qucvle"r tguwtg"y kj lp"vj g'ej co dgt "ku"eqpukf gtgf "kpuki plkecpv O' Vj g'cdqsg"rcvwlpf kcvy"vj cv'cr cvksg"ku"c"eqo r rvg"uwhwt"eqpegpvcvqt"lp"o ci o cO'Xctkcvkpu"lp"uwhwt"eqpvvqv" lp"cr cvksg"ctg"r tqdcdnl "eqptqmgf "d{ "c"ej go kecn'gzej cpi g"tgcwqp"SO₄²⁻ + Na⁺ = PO₄³⁻ + Ca²⁺ + "Nkw"cpf " Ego qf k'3; ; 5+0"Y j gp"vj g'vgo r gtcwtg"lpetgcugu"qt"vj g"xqrcvkg"eqo r qpqpvu"ctg"cf f gf "vq"vj g'u{ ugo. "y j kej" ngy gt "vj g"et{ ucnrk cvkqp"vgo r gtcwtg. "vj ku'tgcwqp"uj lhu"vq"vj g'ngw"r tqo qvki "vj g'hqto cvkqp"qh"j ki j /uwhwt" cr cvksg"cpf "vj g'hqto cvkqp"qh"htgg"ecrekwo "lp"vj g'u{ ugo O'Vj ku"ku"lp"ci tggo gpv'y kj "vj g'o qf gn'r tqr qugf "d{ " *Uo ktpqx"gv'crn0"4239+ "cdqmw"vj g"uci gu"qh"et{ ucnrk cvkqp"qh"r rci kqercug. "ceetf kpi "vq"y j kej "vj g'rko k'qh" ucwcvkqp"qh"vj g'o gn'y kj "y cvgt "ku'tgcj gf "f wtkpi "vj g'gxqnvkqp"qh"o ci o c"XK'y j kej "ngcf u"vq"vj g'hqto cvkqp" qh"j ki j /ecrekwo "r rci kqercug. "cu'y gn'cu"gzr gtKo gpw"Rctcv"cpf "J qn{ . "4227+0Qdxkqwn{ . "vj ku'uci g"eqkpfk gu" y kj "vj g'hqto cvkqp"qh"j ki j /uwhwt"cr cvksg"lp"o ci o cu"qh"XIO

Vj g'o gcuwtgf "eqpegpvcvqp"qh'ej mtkpg"lp"cr cvksgu"xt{ "dgw ggp"305; "cpf "406'y v0" "En"2042/2052" y v0" "lp"i nuugu"qh"vj g'i tqwpf o cuu'cpf "2042/2064'y v0" "lp"O K'K'ku'npqy p"vj cv'vj g'dgj cxkqt"qh'ej mtkpg"lp"

Kpukwsg"qh"Xqrcpqi { "cpf "Ugkuo qni { "HGD'TCU"Rgtqr cxnqxumMco ej cvunf . "Twuuk. "42y /48y "Cwi wuv"423: "

vj g"u{uvg "ku"y gmf'eqttgrcvf"y kj "vj g"dgi cxlqt"qh"y cvgt"cpf "vj g"ej cpi g"lp"vj g"eqpegpvcvkpu"qh"vj gug"eqo r qpgpv"uj qwf "tghge"vj g"r tqegu"qh"cewo wrcvkp"qt"mqu"qh"xqrcvkp0'Ceeqt f kpi "vq"vj g"rcvuv"o qf gni *Y gduvt"gv'crl"4239+"vj g"r gr gpf gpeg"qh"y cvgt"cpf "ej mtlpg"eqpvvp"lp"vj g"o gni'cpf "cr cvkg"ht"tj {qf cekgu"cpf "tj {qrkgu"r hw"8"@UkO i "@205+"cv"72"cpf "422"O Rc"ecp"dg"fguetkdgf"d{ "gs wrcvkp $\frac{y_{H_2O}^{melt}}{x_{Cl}^{melt}} = [(-19.66) +$

(39.13)(X_{OH}^{Ap}/X_{Cl}^{Ap})0Vj g'r cto gvgtu"qh"vj g"gzr gtko gpw'eqttgur qpf "vq"vj g'eqpf kkpup"ht"vj g"gxqmwkp"qh"vj g"o ci o cvk"heq"qh"XK"y j kej "cmqy u"wu"vq"cr r nq "vj g"gvcdkuj gf "f gr gpf gpegu"ht"o qf gni "vj g"dgi cxlqt"qh"xqrcvkp0Y kj "c"tgrcvkg"eqpucpv'eqpvvp"qh"ej mtlpg"lp"vj g"o gni"vj g'y cvgt"eqpegpvcvkpu"xct{ "y kj lp"c"uki ph'ecpvtcpi g"qh"40/80'y v0 "0Wulpi "hpqy p"xctcvkpup"qh"vj g'ej mtlpg"eqpegpvcvkpu"ht"cr cvkgu"cpf "O K"y g"qdcvkpgf "c"urtgcf "qh"y cvgt"eqpvvp"lp"vj g"o gni'htqo "90"vq">30"y v0 "J 4Q0Vj wu"vj g"wr r gt"rko k'qh"vj g"y cvgt"eqpvvp"ku"eqpukvp"y kj "qwt"tgr tgugpvcvkpu"cpf "vj g"o qf gni'fguetkdgf"d{ "Mqvx"gv'crl"4239+0Qpeg"ci clp"eqpht"o u"qwt"kf gc"vj cv'dghgt"vj g"gi cuulpi "vj g'y cvgt"eqpvvp"lp"vj g"o gni'cu'cvcvkpgf "pqv'guu"vj cp"80"y v0 "J 4Q0J qy gxgt"vj g"qdcvkpgf "y cvgt"eqpvvp"ku"guu"vj cp"30"y v0 "j cxg"pqv'r tgxkqwu"dgdp"qdcvkpgf"cpf "ctg"pqv'eqpht"o gf "lp"cpcl"gu"qh'o gni'kpenwkpup0

Rtqxf gf "vj cv"vj g"et {ucnkpkl"qh"vj g"o gni'f qgu"pqv'gzegf "54" . "cpf "vj g"o cuu"htcvkp"qh"cr cvkg"lp"o ci o c"fqgu"pqv'gzegf "2037"y v0 "K'ku'r quikdr"vq"ftcy "eqpenwkpup"cdqvw"vj g"o clp"r j cugu"qh"eqpegv'eqpukf gtgf "o qxcdrg"eqo r qpgpv0Mpqy kpi "vj cv'En'cpf "J 4Q"ctg"eqpegpvcvfg "lp"cr cvkg"cpf "cr r tgecdnq"lp"vj g"o gni'vj kj "vj g"hwkf . "cu"y gni'cu"vj g"eqo r qukkpup"qh"vj gug"r j cugu"kw'ecp"dg"uckf "vj cv"vj g"o clp"eqpvckpgt"ht"y cvgt"cpf "ej mtlpg"pgxgtvj gguu"ku"c"o gni'Uwht . "hwktlpg"cpf "r j qur j qtwa"ctg"cuq"eqpegpvcvfg "o clpnq"lp"cr cvkg . "dw"vj gk"eqpegpvcvkpu"lp"vj g"o gni'ctg"xtg { "ny "C $_{SO_3}^{melt} < 0.021 \text{ wt. \%}$. "C $_{P_2O_5}^{melt} 0.02 - 0.06 \text{ wt. \%}$ "C $_{F}^{melt} 0.05 - 0.09 \text{ wt. \%}$. "vj cv'cmqy u"vq"eqpukf gt"cr cvkg"cu"vj g"o clp"eqpvckpgt"ht"vj gug"eqo r qpgpv0

Vj ku"tgugetej "y cu"uw r qtvf "d{ "THDT"r tqlgeu" 38/27/22: ; 6. " 3: /27/22: 3; + "eqo r rgz"hwf co gpvni'tgugetej "r tqi tco "qh"UD"TCU"K3"i tcpv" 66+cpf "ucvg'tgugetej "r tqi tco "r tqlgeu"2552/4238/2227+0

Tghgtgpegu"

Dwi cnqx . "THOJ kxqt { "qh"vj g'f gxgnr o gpv'qh"vj g'uqwj gtp"ku'puf u"qh"vj g'I tgcw'Mwtkg"cte"lp"vj g'Rgkuvqegpg"II"Phd abstract00 queqy . "3; ; 60R042"lp"Twuulcp+0

I qtuj nqx "I UOXqrecpkuo "qh"vj g'Mwtki'Ku'puf u"Cte"II"O Q'P cwne . "3; 890R06; "lp"Twuulcp+"

Uo ktpqx"U0 0'T {dlp"C0K0"Uqnmqxc"GP 0'Mw o lp"FOK0"Fi vgtgx"C0K0"Vko kpc"VQ 0'Hgnke"o ci o cu"qh"vj g"ecrf gtc/htqo kpi "gtw vkpu"qp"vj g"Kwtw "Ku'puf < vj g"htuv"tguwu"qh"uwf lgu"qh"o gni'kpenwkpup"lp"r j gpqet {uw"htqo "r wo legu"qh"vj g"Nxlpc {c"Rcu"cpf "Xgtqxq { "Kvj o wu"ecrf gtcu"II"Russian Journal of Pacific Geology, 4239. " 33"3+Rr "68/850

Fqj gtq "C0N0"Y gduvt "LF 0'I qrf qh'D0C0"Rleeqr'R00 0'Rctvkplpi "dgi cxlqt"qh'emtlpg"cpf "hwktlpg"lp"hgule"o gni'hwkf *u+cr cvkg"u{uvg u"cv'72"O Rc"cpf " 72/; 72"AE"II"Chemical Geology."42360" 5: 60Rr " 6/3330

Y gduvt "LF 0"Vcr r gp"E0"cpf "O cpf gxkng"E0'Rctvkplpi "dgi cxlqt"qh"ej mtlpg"cpf "hwktlpg"lp"vj g"u{uvg "cr cvkg/o gni'hwkf =K'Hgnke"ukdecv"u{uvg u"cv'422"O Rc0"II"Geochimica et Cosmochimica Acta."422; 0 95."Rr "77; 67: 30

Y gduvt "LF 0'I qrf qh'D0C0"Hguej "T0P 0'P cf gcw'R0C0"Ukdgt'COY 0J {ftqz {n"En'cpf "H'r qtvkplpi "dgvy ggp"j ki j /uklec"tj {qrkle"o gni'cr cvkg/hwkf *u+cv'72/422"O Rc"cpf "922/3222"AE"II"American Mineralogist."42390X0240Rr "83/960

Nkw[0'cpf "Eqo qf K'R0Uqo g"cur gew"qh"vj g"et {ucn'ej go knt { "qh"cr cvkgu"II"O kpgtcni kecn'O ci c| kpg."3; ; 50 X0790Rr "92; /93; 0

Rtecv'HO'cpf "J qm "HO'Uwht"r ctvkp"eqghelgpv'dgy ggp"cr cvkg"cpf "tj {qrkg<vj g"tqng"qh'dwmi'U'eqpvvp"II"Contrib Mineral Petrol."42270X0720Rr "865/8730

Mqvx"C0C0"Uo ktpqx"U0 0"O cmiko qxlej "K0C0"Rgej qx"RQ w0"Ej gtuvqxc"P0K0"Dghwu"C0K0"Y cvgt"lp"o gni'kpenwkpup"htqo "r j gpqet {uw"qh"fcvkg"r wo leg"qh"Xgtqxq { "Kvj o wu"Kwtw "Ku'puf . "Uqwj gtp"Mtkgu"II" IOP conference Series: Earth and Environmental Science, 42390X0320"

O cmiko qxlej "K0C0"Uo ktpqx"U0 0"Mqvx"C0C0"Vko kpc"V0[w0"Uj gxmq"C0[c0'O ci o c"uqtci g"eqpustckpu"d{ "eqo r qukkpcri"qplpi "qh'r rci kqercug"htqo "f cekgu"qh'ecrf gtc"htqo kpi "gtw vkpu"qh"Xgtqxq { "Kvj o wu"cpf "Nxlpc {c"Rcu'Dc { "Kwtw "Ku'puf . "Mtkg"Ku'puf u"II" IOP conference Series: Earth and Environmental Science, 42390X0320