Geophysical Research Abstracts
Vol. 18, EGU2016-4252-5, 2016
EGU General Assembly 2016

Implication of the monomineral eclogite thermobarometry for the reconstruction of the PT conditions and origin of mantle eclogites in the structure of Siberian and other cratons.

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Enhanced monomineral thermobarometry for clinopyroxenes and garnet (Ashchepkov et al., 2015) allow reconstruction of thermal conditions for the mantle eclogitic xenoliths and xenocrysts of omphacites and pyrope almandine garnets of eclogitic and megacrystic types.
Three common groups according to Dawson,(1977) A. Mg - eclogites; B. common subduction-related basaltic eclogites and C. Na-Fe- rich eclogites. In addition group D compile Ca-Al rich varieties (Spetsius et al., 2008; Viljoen et al., 2010). We subdivided these groups and their positions in mantle lithosphere sections beneath the most studied pipes in Yakutia and most interesting localities Worldwide.
Group A including Al-rich and low groups are restites or cumulates from the ancient komatiitic basalts or boninites. The Fe# for olivine in equilibrium is 0.05 -0.11 using melt -solid partition coefficient ∼0.33 for Fe (Albarede, 1992). For the group B Fe# of the omphacites are ∼ 0.11- 0.23 and they could be only cumulates from melted subducted MORB basalts or reactional products. The higher values of Fe –Na-Al rich group C (Fe# ∼0.25-0.4) could relate to the subducted basalts or Al - rich sediments (Spetsius et al., 2008) or Mg-rich crustal rocks which were subducted without much melting. Group D Ca-rich eclogites are commonly low Fe but subduction related varieties (Dongre et al., 2015) could be higher in Fe and Na.
Partition coefficients of the trace elements between Gar and Cpx for most mantle eclogites relate to equilibration with the melts and REE patterns show different inclinations, while crustal eclogites which re-equilibrated in the solid state often show the same inclinations.
Groups A1: a Cr-bearing group formed after crystallization of partial melts produced by volatile fluxes generated by ancient subduction (Heaman et al., 2006; Smart et al., 2009); A2 - low - Al cumulates and restites from komatiitic melts (Aulbach et al., 2011); A3 - low-Cr group which could be restites (Wyman and Kerrich, 2009) or deep cumulates from tonalite- trondhjemite or Mg-rich boninitic arc magmas (Horodytskyi et al., 2007; Barth et al., 2002); A4 a group derived by crystallization of differentiated protokimberlite melts (Haggerty et al., 1979; Kamenetsky et al., 2009).
The largest group B with Fe# (∼ 0.15-0.25, moderate in Al and Na values, commonly reveal Eu anomalies. The GrB1 interpreted as subducted metagrabbro close to MORB (Jagoutz et al., 1974; Beard et al., 1996; Pearson, 1995; Snyder et al., 1997) reacted with oceanic water (Neal et al., 1990). Enriched Group B2 eclogites are thought to be products of fluid melting of ancient oceanic crust and interaction with peridotites during subduction (Aulbach et al., 2007). Group B3 eclogites (>3 GPa) may be basaltic cumulates derived from plume or ancient arc magmas in cratonic margins (Wyman and Kerrich, 2009); those near Moho may be eclogitized lower crustal cumulates (Shu et al., 2014). Group B4 eclogites are results of hybridization of subducted basalts with protokimberlite and other plume melts (Shatsky et al., 2008 -2015).
High-Fe -Na Group C1 eclogites (Fe# > 0.27) may be subducted Fe- basalts; Ca-enriched varieties may be meta-tonalites or trondhjemites (Group C2) (Barth et al., 2002) and those which are very rich in Al could be metasediments (Group C3) (Mazzone and Haggerty, 1989).
High –Ca- Al GrD1 are rare high-Ca and low-Fe varieties, commonly Al-rich and kyanite-bearing (sometimes with coesite) (grosspydites) which may be originally carbonate metasomatites (Smyth, 1977) or metapelites (Liou et al., 2014); Group GrD3 eclogites are high-Ca and moderate-Fe and may be ancient Mg-granites (Barth et al., 2002; Jacob et al., 2003) .
According to the thermobarometry GrA eclogites are distributed mostly in the lower (L) and- middle parts of SCLM and correspond to low - temperature thermal gradients.

GrB2 eclogites form trends of increasing Fe# for garnets and omphacites with decreasing pressure. This could be due to the progressive melting of subducted basalts (Rosenthal et al., 2014) or an opposite due to crystallization of evolving partial melts from primary eclogites. In USCLM the GrB3 omphacites show reactional trends with decreasing Fe# upward or an opposite progressive rise due to magmatic differentiation.
GrC dominate the middle part of the SCLM (3-4 GPa) and mostly correspond to the layer originated in the Early Archean time at 3.5-4.0 GPa possibly due to subduction of the tonalitic crust and related metasediments.
CrD1 -rich grosspyditic varieties from India, Siberia and South Africa are relatively low-Fe and Al-rich and possibly are metasomatites or products of interaction of sediments and peridotites. The other Ca- rich varieties most likely are subducted anorthosites or rare granites.
Supported by the RFBR grants: 05-05-64718, 03-05-64146, 11 -05-00060, 11-05-91060-PICS, 16-05-00841, 16-05-00860 and projects 77-2, 65-03, 02-05 UIGGM SB RAS and ALROSA Stock Company