Geophysical Research Abstracts
Vol. 19, EGU2017-14018, 2017
EGU General Assembly 2017

MOR vs SSZ origin of the Aladağ ophiolite (S-Turkey): implications from clinopyroxene geochemistry

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The Aladağ ophiolite is located in the eastern Taurides, north of the city of Adana, southern Turkey. From bottom to top it is composed of mantle peridotites, ultramafic-mafic cumulates, isotropic (massive) gabbro and diabase dykes. Mantle peridotites, represented by varying degrees of serpentinized dunite, harzburgite and lherzolite, are divided into two subgroups according to spinel Cr# and Lanthanum Group Element (LGE) contents. Group-1 mantle peridotites contain spinel with low Cr# [100×Cr/(Cr+Al) = 13-47] values and relatively high heavy LGE contents whereas Group-2 mantle peridotites contain spinel with relatively higher Cr# (44-74) values and lower heavy LGE contents.

Clinopyroxene in the Aladağ mantle peridotites are diopside in composition. Clinopyroxenes from the Group-1 samples have TiO_2 contents up to 0.37 wt.% and Na2O contents up to 0.89 wt.%. Conversely, the Group-2 clinopyroxenes were relatively depleted compared to the Group-1 clinopyroxenes in terms of TiO_2 (<0,1 wt.%) and Na2O (<0.56 wt.%) contents. The $Al2O_3$ contents are between 0.36-5.75 wt.% for the Group-1 clinopyroxenes and this value is relatively low and range between 0.06-2.68 wt.% for the Group-2 clinopyroxenes. Chondrite-normalized LGE patterns of clinopyroxene in the Group-1 and the Group-2 samples differ from each other. While the Group-1 clinopyroxenes show almost flat HLGE to MLGE patterns (DyN/LuN= 0.35-1.30 avg; 0.75), the Group-2 clinopyroxenes are represented by a more significant depletion from HLGE to MLGE (DyN/LuN= 0.04-0.41 avg; 0.19). Ti and Dy contents of clinopyroxene from the Group-1 samples range between 320-2536 ppm and 0.43-2.4 ppm, respectively. However, the Group-2 clinopyroxenes contain rather lower Ti and Dy contents compared to Group-1 clinopyroxenes, varying from 34 to 289 ppm and 0.02 to 0.20 ppm, respectively. The major oxide composition and LGE patterns as well as Ti and Dy contents of the clinopyroxenes indicate that Group-1 samples are relatively lower-degree partial melting residue left after melting in the mid-ocean ridges, while the Group-2 samples are higher degree partial melting residue at suprasubduction zone. The high Ti versus Dy and Zr contents of Group-1 clinopyroxenes support that they are dry melting residues at mid-ocean ridge setting; however, lower Ti contents for a given Zr contents of Group-2 clinopyroxenes imply that these clinopyroxenes are formed as a result of hydrous partial melting.

This study was supported by #114Y094 TUBITAK project