



From Subduction to Obduction: new insights on the obduction process through the study of the metamorphic sole of the Amasia ophiolites (Lesser Caucasus, Armenia)

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Outcrops of preserved oceanic lithosphere overthrust onto the continental South Armenian Block (SAB) from the north are found throughout the Lesser Caucasus. Previous works using geochemical whole-rock analyses, $^{40}\text{Ar}/^{39}\text{Ar}$ and paleontological dating have shown that the ophiolite outcrops throughout this area were emplaced during the Upper Cretaceous as one non-metamorphic preserved ophiolitic nappe of back-arc origin that formed during Middle to Late Jurassic. This domain is limited to the North along the Sevan-Akera suture zone (SAS) by a fossil subduction under the southern Eurasian Margin (active from Middle Jurassic to Late Cretaceous times). Two thrust fronts, to the South, are found near Vedi (Armenia) and Khoy (Iran). The Armenian ophiolites show a variety of visible basal contacts considering structural and metamorphic settings. In the locality of Stepanavan (50 km east of Amasia along the SAS) blueschists evidence a fossil subduction zone active prior to or contemporary to obduction. In Amasia, $^{40}\text{Ar}/^{39}\text{Ar}$ dating, microprobe mineral characterization and thermodynamic modeling using *Perple_X* of a basal sliver of garnet amphibolites bring evidence of anticlockwise PT path. Two metamorphic steps are identified: a HT-LP peak of $P = 6-7$ kbar and $T > 630^\circ\text{C}$ followed by a clearly marked greenschist facies overprint (M2: MP-MT peak at $P = 8-10$ kbar and $T = 600^\circ\text{C}$). The greenschist facies conditions are analog to those of the ophiolitic "melange", in which is found the garnet amphibolite sliver, separating the ophiolite from the underthrust continental domain (SAB). Considering this unit to be part of the metamorphic sole of the Armenian ophiolitic nappe, we bring crucial P-T-t precisions to the obduction process in the Lesser Caucasus. We emphasize the constrained time span for ophiolite emplacement argued by the Ar/Ar ages (91-90 Ma, Cenomanian-Turonian) for metamorphism and paleontological ages (Coniacian-Santonian) determined from series directly underlying and overlying the ophiolite obduction front.

The westward extension of the Lesser Caucasus ophiolitic nappe is believed to be the NE Anatolian ophiolites. The study of the Refahiye ophiolite near Erzincan has identified a well foliated low metamorphic grade volcano-sedimentary unit directly under the ophiolite to the north of the North Anatolian Fault pull-apart basin. This further emphasizes the variability of the material which may be incorporated to form the metamorphic sole, whether it is an ophiolite with a MORB signature overlain by (1) supra-subduction volcanics with a TAB signature or (2) seamounts with an OIB signature. The variable geochemical compositions of the basal metamorphic rocks which endured the obduction of the ophiolite is thus interpreted as resulting from the disappearance of corresponding domains through underthrusting, tectonic erosion, scaling and mixing.