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Discovery and geodynamic significance of blueschists in north Armenia

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Introduction

In Northern Armenia, fieldwork supported by the MEBE program allowed to discover a blueschist sequence, preserved within a complex tectonic pile (the Stepanavan Blueschist Ophiolitic Complex, SBOC). We observed five superimposed units in the SBOC: The blueschist Unit; The ophiolite complex; The lower volcano-sedimentary unit (LVSU); The upper volcano-sedimentary unit (UVSU) and Plio-quaternary volcanics. At the geological map scale, the overall structure is that of a folded nappe pile formed by thrusting and folding towards the North. The study of metamorphism of blueschists shows mainly two stages of metamorphism at (1) HP-LT and (2) MP-MT. Preliminar Ar-Ar dating shows that stage 1 occurred at c. 94 Ma, and stage 2 at 71.1 $\pm$ 0.3 Ma (1σ).

Main text *Units*

We observed five superimposed units in the SBOC, from base to top:

1. The blueschist Unit, is composed of metasediments: calcschists, metaconglomerates, quartzites, gneisses and metabasites. This association suggests an active margin detrital environment typical of accretionary prisms. The protolith age is unknown.

2. The ophiolitic complex, composed of: serpentinites, gabbro-norite pods, plagiogranite, basalts and radiolarites suggesting a slow-spreading Lherzolite Ophiolitic Type (LOT). In the North, we observed the following succession: serpentinite, flaser-gabbro basalt and radiolarites. In the South, principally serpentinites, and pods of cumulative gabbro-norites, evolving to plagiogranites by Fractional Crystallization. The ophiolite is a probable lateral equivalent of the ophiolitic series described in the Sevan area (see the presentation of Sosson et al. in the same session; Zakariadze et al., 1983). A radiolarian assemblage extracted from radiolarites intercalated within lavas are Late Jurassic in age (mid/late Oxfordian to late Kimmeridgian/early Tithonian; Unitary Association Zones 9 to 11 of the biozonation of Baumgartner *et al.* 1995).

3. The lower volcano-sedimentary unit (LVSU), comprised of: basal conglomerates or quartzites, red pelites, limestones and finally graywackes or andesitic lavas. Depending on the area, we observed either: (i) the succession of a thick sandstone/conglomerate layer and black grauwackes interlayered with several decameter-large limestone strata (North, see lithological profile A), or (ii) the succession quartzite and conglomeratic limestones, a reduced pile of pelites, and a large thickness of andesites, basaltic andesites and andesitic tuff. The possible age range for this succession is Lower Cretaceous-Paleocene, as it lies unconformably on the ophiolite and predates the following Paleocene (?) unconformity.

4. The upper volcano-sedimentary unit (UVSU) is comprised of: basal conglomerates with volcanic blocks and glauconite, tuffaceous limestones, and andesites to rhyolites lavas. This series is presumably Paleocene-Eocene (in reference to the Geological Map of Armenia 1/5000 000) and lies unconformably on the folded LVSU.

5. Plio-quaternary volcanics, which lie just north to NW-SE normal faults crosscutting the SBOC.

Structure

At the geological map scale, the overall structure is that of a folded nappe pile. Folds are oriented N100-120˚E. Fold axial planes are vertical to slightly south-dipping. Fold axes are sub-horizontal.

The blueschist unit appears within two tectonic windows of $\pm$ 1 km^2, due to the presence of steep reverse north-verging faults in the core of two E-W anticlines. The SBOC is crosscut by later NW-SE north dipping normal faults. The study of ductile deformation within the Blueschits Unit reveals the presence of two generations of stretching

+ mineral lineations and associated metamorphic foliations. The first generation is underlined by minerals of the blueschist facies (glaucophane + phengite), and strikes N90-110˚E. The second generation is underlined by minerals of the greenschist facies (epidote, actinolite), and strikes mainly N-S to NE-SW. Both greenschist and blueschist facies foliations are refolded within N120˚E folds. Therefore we suggest the following succession of tectonic events: (1) a first E-W displacement of blueschists units at HP ($>$ 5 kbar), (2) a second NE-SW north-verging thrusting phase, contemporaneous to greenschist facies conditions resulting in the superposition of nappe. (3), in the same tectonic context, the nappe stack is refolded in a northeast verging shortening direction.

Metamorphism

Stepanavan blueschists bear two parageneses: (1) a HP-LT paragenesis defined by blue amphibole and zoïsite-type epidote (glaucophane-crossite), (2) a MP-MT paragenesis defined by epidote and phengite $\pm$ blue-green amphibole.

Preliminary P-T estimates based on the HP paragenesis provide a PT estimate of 1.1 $\pm$ 0.1 GPa and 480 $\pm$ 70˚C, while P-T conditions on the LP paragenesis are of P $<$ 0.7 GPa and T $<$ 500˚C.

Preliminary Ar-Ar dating

Ar-Ar ages have been obtained on white micas from Stepanavan blueschists, with Ar-Ar dates of blueschist metamorphism at c. 94 Ma. Retrogression of blueschists in the epidote-amphibolite facies is dated at 71.1 $\pm$ 0.3 Ma (1σ).

Conclusions

The blueschist rocks found in Stepanavan area are the only relicts found in Armenia. Thus they provide a good evidence of tectonics prevailing during the subduction of the ocean just north to the South Armenian Block. This zone of subduction is possibly the lateral equivalent of the blueschist belt described in North Anatolia, and indicates the same succession of events as the Shyok Suture in NW Himalaya.

References

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