Journal of Economic Geology
Vol. 7, No. 2 (2015-2016)
ISSN 2008-7306

مجله زمین‌شناسی اقتصادی
جلد ۷، شماره ۲ (سال ۱۳۹۴)
صفحات ۵ و ۶

Petrology of blueschist and meta-greywacke along the Turkmeni-Ordib fault (Turkmeni area, SE of Anarak)

Fereshteh Bayat* and Ghodrat Torabi

Department of Geology, University of Isfahan, Isfahan, Iran

Submitted: Dec. 21, 2013
Accepted: Oct. 25, 2014

Key words: *Blueschist, Turkmeni-Ordib fault, subduction, Paleo-Tethys, Central Iran.*

Introduction

The occurrence of blueschist metamorphic facies is believed to mark the existence of former subduction zones. This facies is represented in the main constituents of subduction-accretion complexes, where it occurs in separate tectonic sheets, imbricated slices, lenses, or exotic blocks within a serpentinite mélange (Volkova et al., 2011). The evidence of the presence and maturity of Paleo- Tethys oceanic crust in the CEIM (define this) in Paleo-Tethys branches, subduction and collision has been studied by various authors (Bagheri, 2007; Zanchi et al., 2009; Bayat and Torabi, 2011; Torabi 2011). Late Paleozoic blueschists have recognized in the western part of the CEIM (e. g. Anarak, Chupanan and Turkmeni) in linear trends. Metamorphic rocks of the Turkmeni area (SE of Anarak) are composed of blueschist and meta-greywacke and are situated along the Turkmeni-Ordib fault associated with Paleozoic rock units and serpentinized peridotite bodies. Turkmeni blueschist and meta-greywackes have not been studied by previous workers.

The Turkmeni blueschists consist of albite, winchite, actinolite and epidote. Granoblastic, nematoblastic and lepidoblastic are main textures in these rocks. Winchite is found in the matrix and around epidote grains. This sodic-calcic amphibole serves as an index mineral in blueschist facies. Actinolite and epidote formed during retrograde metamorphism of blueschists in the greenschist facies. The mineral assemblage of albite, epidote, chlorite and phengite ± garnet is present in meta-greywackes in the Turkmeni blueschists. Veins of garnet, muscovite, quartz and opaque minerals are extensive in these rocks. Epidote and chlorite formed in meta-greywackes by retrograde metamorphism in the greenschist facies. The aim of the present study is to determine the petrological and geochemical characteristics, P-T condition of blueschists and meta-greywackes, as well as the geotectonic setting of primary basaltic rocks of the Turkmeni blueschists.

Material and methods

This study is based on field observations and petrographical and analytical studies. Satellite images and a geological map were prepared. About 20 thin sections were supplied for petrological studies. Mineral chemical analyses were carried out by a JEOL JXA-8800R electron probe micro-analyzer (EPMA) at the Cooperative Center of Kanazawa University, Japan. The analyses were performed under an accelerating voltage of 15 kV and a beam current of 15 nA with 3µm probe beam diameter. The Fe^{3+} contents of minerals were estimated by assuming ideal mineral stoichiometry. The representative mineral compositions are given in Tables 1-3. Major oxides, rare earth elements (REE) and trace elements of five blueschists samples were analyzed by the ICP-MS method (Kanpanzhouh Research Company, Tehran, Iran) of the SGS laboratory of Canada. Whole rock chemical data are presented in Table 4.

Results and discussion

Petrographical and geochemical characteristics of Turkmeni blueschists reveal that they were derived from a similar mantle source and underwent analogous melt extraction and post magmatism occurrences. According to the trace and rare earth elements contents, the protolith of blueschists should be formed by crystallization of tholeiitic basalt and have sub-alkali basalt nature.

*Corresponding authors Email: fereshtehbayat2011@gmail.com

Blueschists have LREE values more than HREE. High amounts and evident variations of LIL elements are obvious. Negative anomalies of HFSE such as Nb, Hf, Zr and Ti are evident in Turkmeni blueschist. REE trends of these rocks resemble as the back arc basin basalts. Based on the Nb/La ratio and REE contents, the original magma has been generated by low to medium degree of partial melting of a lithospheric mantle spinel lherzolite. Geochemical characteristics and normalized diagrams reveal that primary magma of protolith has been nature near to IAB and E-MORB. The related processes to subduction of Paleo-Tethys oceanic crust led to mantle enrichment and carbonate metasomatism. The Paleo-Tethys Ocean spreading in CEIM commenced in Late Ordovician and terminated in the Late Paleozoic-Triassic. Association of meta-greywackes with blueschist and LILE/HFSE contents shows that Paleo-Tethys oceanic crust subduction zone at Turkmeni region was been immature. Mineral chemistry and assemblages of the blueschists and meta-greywackes units reveal that they suffered different metamorphic evolution: (M1) greenschist metamorphism by existence of actinolite and albite in basaltic rocks, and then they passed a prograde metamorphism in the blueschist facies by existence of winchites (M2) which is followed by a retrograde metamorphism P-T condition in the greenschist facies (M3). Variscan tectono-metamorphism occurrence has been main metamorphic phase in Anarak region and it has led to metamorphism in blueschist facies of Turkmeni rocks.

Acknowledgments
The authors wish to thank the University of Isfahan University for financial supports.

Reference

Bagheri, S., 2007.The exotic Paleo-tethys terrane in Central Iran: new geological data from Anarak, Jandaq and Posht-e-Badam areas. Ph.D. thesis, Faculty of Geosciences and Environment. University of Lausanne, Switzerland, 208 pp.

Bayat, F. and Torabi, G., 2011. Alkaline lamprophyric province of Central Iran, Island Arc, 20(3): 386-400.

Torabi, G., 2011. Late Permian blueschist from Anarak ophiolite (Central Iran, Isfahan province), a mark of multi-suture closure of the Paleo-Tethys ocean. Revista Mexicana de Ciencias Geológicas, 28(3): 544-554.

Volkova, N.I., Travin, A.V. and Yudin, D.S., 2011. Ordovician blueschist metamorphism as a reflection of accretion-collision events in the Central Asian orogenic belt. Russian Geology and Geophysics, 52(1): 72-84.

Zanchi, A., Zanchetta, S., Garzanti, E., Balini, M., Berra, F., Mattei, M. and Muttoni, G., 2009. The Cimmerian evolution of the Nakhlak – Anarak area, Central Iran, and its bearing for the reconstruction of the history of the Eurasian margin. Geological Society, London, Special Publications, 312: 261-286.