Sedimentary environment, diagenesis and geochemistry of carbonate rocks of Bahram Formation (Middle-Late Devonian) in Qaleh-bala section (Ozbak-kuh, east of Iran)

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Introduction

Bahram Formation (Middle-Late Devonian) is the second stratigraphic unit of the Ozbak-kuh Group in east of Central Iran. It generally consists of bluish-gray to gray limestones which gradually covers dolomites of the Sibzar Formation and is overlaid by Shishtu Formation or with an erosional contact in some regions (Aghanabati, 2010). Most of the previously published works, (e.g. Ahmadi & Ashuri, 1998; Bahari *et al*., 2006; and Ahmadzadeh Heravi *et al*., 2007), have had mainly focused on biostratigraphy and lithostratigraphy of Bahram Formation. But in recent years, some other studies about microfacies, sedimentary environment, sequence stratigraphy and paragenetic sequence of Bahram Formation have been carried out by Rostamnezhad *et al*. (2012), Hashemi *et al*. (2012) and Hoseinabadi *et al*. (2013). In this research, a stratigraphic section of carbonate rocks of Bahram Formation with 332 m thickness in the east of Ozbak-kuh village, north of Tabas city (Southern Khorasan Province), has been measured, sampled and studied. This sequence generally has been made of gray colored, thin to thick bedded limestones.

Discussion

Based on detailed petrographic studies, all limestone samples have been assigned to one of the 11 different carbonate microfacies as follows: (I_1) Dolomitized Mudstone, (I_2) Lime Mudstone, (I_3) Peloidal Mudstone/Wackestone, (I_4) Bioclastic Wackestone/Packstone, (I_5) Peloidal Grainstone, (M_1) Bioclastic Grainstone, (M_2) Intraclastic Floatstone/Packstone, (O_1) Bioclastic Packstone/Grainstone, (O_2) Burrowed Bioclastic Wackestone, (O_3) Peloidal Wackestone and (O_4) Sponge Spicule-bearing Silty Mudstone. These microfacies were deposited within five different facies belts including tidal flat, lagoon, tidal channel, shoal and open marine belts. Based on vertical changes of facies, there is no evidence of re-deposited sediments, turbidite facies or even persistent reef structures which indicates a gentle homoclinal ramp-shaped carbonate platform.

Based on the microscopic evidences, the most significant diagenetic processes affected the Bahram Formation samples are compaction, micritization, bioturbation, neomorphism, cementation, dolomitization, fracturing, dissolution and cavity fillings. Also, different types of sparry calcite cement such as fibrous, dog tooth, granular, bladed, equant mosaic, drusy mosaic and syntaxial overgrowth were identified that had been formed in marine, meteoric and burial diagenetic environments. In addition, four distinct types of dolomites have been found that are formed in early marine and deep burial diagenetic stages. Generally, interpreted paragenetic sequence confirms that the phreatic meteoric diagenetic stage has had the most effect on the studied samples.

Geochemical data were obtained from analysis of Ca and Mg major elements and Mn, Fe, Sr and Na minor elements within the appropriate selected samples using Atomic Absorption Spectrophotometry method. The low amounts of Sr and Na, low Sr/Mn ratio as well as relatively high values of Mn confirm effect of meteoric diagenesis on these samples. Comparison of Sr/Na ratio of the studied samples with the published recent temperate and tropical examples suggests that the palaeoenvironment of the Bahram Formation is very similar to the recent temperate regions. Moreover, the Sr/Ca ratios indicate that these carbonate rocks, geochemically, have been affected by open-system during different diagenetic stages.

Results

Based on the field and petrographic studies, totally eleven different carbonate microfacies have been identified. These microfacies have been deposited in five different facies belts within a ramp-type carbonate platform. The most significant diagenetic processes that have been affected the Bahram Formation samples are compaction, cementation, dolomitization, dissolution and cavity fillings, bioturbation and fracturing. Interpretation of paragenetic sequence of the studied limestones reveals the effects of diagenetic processes in marine, meteoric and burial environments. Elemental analysis indicates that aragonite was primary mineralogy for these limestones and also show that the palaeoenvironment was similar to the recent temperate regions. Diagenetic environment of these carbonate rocks has had an open-system geochemically.

Keywords: Bahram Formation; Ozbak-kuh; Middle-Late Devonian; carbonate ramp; diagenesis; geochemistry

References

Aghanabati, A., 2010. Geology of Iran. *Geological Survey of Iran*, 586 p. [in Persian].

Ahmadi, N., & Ashouri, A., 1998. Investigation on Bahram Formation conodonts in Kuh-e-Faghan, south of Kashmar. *Proceedings of the 2nd Seminar of Geological Society of Iran*, 6 p. [in Persian].

Ahmadzadeh Heravi, M., Ashuri, A., & Gandomi, R., 2007. Study of Bahram Formation brachiopods at Cheshmeh-shir section (Ozbak-kuh, NE Tabas). *Proceedings of the 7th Seminar of Geological Society of Iran*, 6 p. [in Persian].

Rafat Bahari, T., Khaksar, K., & Ashouri, A., 2006. Study of Late Givetian-Frasnian corals of Bahram Formation, south of Ozbak-kuh. *Geosciences Quarterly*, 59: 56-69 [in Persian].

Hashemi, A., Ghorbani, M., Rezaei, P., Rostamnezhad, A., Gholamian, H. & Nikbakht, F., 2012. Diagenetic processes and paragenetic sequence of Bahram Formation in Sardar section, north of Kerman. *Proceedings of the 1st Seminar on Geology of Iran Plateau*. , 6 p. [in Persian].

Hoseinabadi, M., Mahboubi, A., Mirab Shabestari, G., & Motamed, A., 2013. Microfacies and sedimentary environment of Bahram Formation in Cheshmeh-shir section, NE Tabas. *Proceedings of the 32nd Seminar and the 1st International Professional Congress of Earth Sciences, Geological Survey of Iran*, Mashad Branch, pp. 435-441 [in Persian].

Rostamnezhad, A., Ghorbani, M., Rezaei, P., & Hashemi, A., 2012. Study of lithofacies, sedimentary environment and diagenetic features of Bahram Formation in north of Kerman (Hootak section). *Proceedings of the 31st Seminar of Earth Sciences, Geological Survey of Iran*, 7 p. [in Persian].