Depositional facies and regional paleogeography of the Lower Carboniferous Mobarak Formation in the Alborz Basin, northern Iran.

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The succession of Tournaisian and Viséan sediments in the central Alborz Mountains (Northern Iran), represents one of the most complete and well-known Persian Paleozoic successions. The Mobarak Formation (Tournaisian-Viséan), which is more than 200 m thick, represents the development of an extensive carbonate factory following the opening of the Paleotethys Ocean into the Alborz basin at the northern margin of Gondwana. The carbonate ramp morphology on the southern Paleo-Tethyan passive margin was particularly susceptible to the influence of storms, as evidenced by the presence of numerous storm deposits in the Mobarak Formation. Our study aims to improve the knowledge on the parameters controlling the development and growth of the carbonate ramp during the Lower Carboniferous. Furthermore, climatic variability at the Northern margin of Gondwana need to be better documented. To study climate variability, we selected four outcrops located in the central Alborz Mountains: the Jaban, Aroo, Shahmirzad and Labnesar sections.

In these sections, depositional facies range from the most proximal to the most distal and include coastal, inner ramp peritidal facies, peloidal to crinoidal shoals, storm to fair-weather influenced mid-ramps,

proximal to distal shell beds and low energy outer ramps. Clearly, storms played a dominant role in distribution of skeletal and non-skeletal banks on the carbonate ramp.

The foraminiferal sequence in our samples is similar to that described from the Mobarak Formation in previous papers (Ueno et al., 1997; Brenckle et al., 2009), although foraminifers are restricted to several intervals, and are not distributed evenly throughout the section. Three foraminiferal assemblages are recognized in the sections studied. The assemblage with *Granuliferella latispiralis* (Jaban and Labnesar sections) corresponds to the lower part of the Upper Tournaisian and the lower portion of the Ivorian, MFZ4-MFZ5 (Hance et al., 2006, 2006a; Hance et al., 2011) and correlates with the Lower Kizelian in the Urals and Upper Cherepetian of the Russian platform (Kulagina et al., 2003). The second assemblage with *Eotextularia diversa* (Jaban, Aroo, Shahmirzad and Labnesar sections) corresponds to the Cf3 foraminiferal zone of the Franco-Belgian Basin (Conil & Lys, 1977; Conil et al., 1991), upper part of the Ivorian, MFZ6-MFZ7 (Hance et al., 2006, Hance et al., 2011) and corresponds to *E. diversa* Zone of the Russian Stratigraphic Scale (Kulagina et al., 2003). The third assemblage with *Eoparastaffella* ex gr. *rotunda* (Jaban and Labnesar sections) corresponds to the uppermost Ivorian (uppermost Tournaisian), MFZ8 (Hance et al., 2006, 2006a; Hance et al., 2011) and correlates with *E. rotunda* Zone of Russia.

Based on the palynological observations in the argillaceous limestones, the acritarch assembly is dominated by small-sized (around 40 μm) *leiospheres* and *Micrhystridium* with small spines. In addition, larger palynomorphs are scarcely present. They probably represent spores of the terrestrial flora, although the trilete mark is generally poorly distinguishable, preventing conclusive identification.

The acritarch assembly possibly indicates either a deep water environment or an outer carbonate shelf environment (Dorning, 1981; Dorning and Bell, 1987). However, the presence of rare phytodebris and trilete spores suggests a local terrestrial sediment input. The scarcity of acritarchs does, however, point to a relatively distal depositional environment. Those observations suggest that the land was poorly covered by vegetation probably due to arid conditions. The small size of the palynomorphs could be a result of high-energy sedimentary settings.

During the Early Carboniferous, two glaciations and one tectonic phase have been described as the principal factors controlling carbonate platform evolution: (1) the Hastarian–Ivorian boundary glaciation phase (Caputo et al., 2008), (2) Upper Ivorian–Lower Viséan? tectonic block faulting and (3) the Viséan-Serpukhovian glaciation phase (Rygel et al., 2008; Haq and Schutter, 2008). The Upper Hastarian–Lower Ivorian glaciations were identified in Southern Gondwana, but their influence has not yet been clearly identified in Northern Gondwana. The Upper Hastarian–Lower Ivorian glaciation is recorded by the appearance of inner-ramp channel-form facies in the mid– and outer-ramp settings. During Upper Ivorian–Lower Viséan?, differentiation block faulting along the basin's margin caused uplift in the most western part of the Alborz basin and a sub marine collapse in the eastern part of the central basin. The uplift caused vast sub-aerial exposure and the formation of breccias beds in the top of the Mobarak Formation at the Jaban and Aroo sections. The sub-marine collapse was recorded by the occurrence of *Zoophycos* ichnofacies in the fine-grained limestones at the top of the Labnesar and Shahmirzad sections. The erosional phase that set off by tectonic activity was followed by considerable and abrupt sea level falls as an indirect consequence of the Viséan and Serpukhovian glaciation phases. This progressive sea level drop led to stagnation of the carbonate factory, which is represented by an erosional surface at the top of the Mobarak Formation. The sedimentation only continued into the Carboniferous in several local embayments that are preserved as the Dozdeband, Ghezel-Ghaleh and Bagher Abad Formations.

References:

Brenckle P. L., Gaetani M., Angiolini L., Bahrammanesh (2009). Refinements in biostratigraphy, chronostratigraphy, and paleogeography of the Mississippian (Lower Carboniferous) Mobarak Formation, Alborz Mountains, Iran. GeoArabia, 14 (3), 43-78.

Caputo, M. V., Melo, J.H.G., Streel, M., and Iabell, J.L (2008). Late Devonian and Early Carboniferous glacial records of South America. The Geological Society of America, special paper, 441-411.

Conil, R., Lys, M (1977). Les transgressions dinantiennes et leur influence sur la dispersion et l'évolution des foraminifères. Mémoires de l'Institut Géologique de l'Université de Louvain, 29, 9-55.

Conil, R., Groessens, E., Laloux, M., Poty, E., Tourneur, F (1991). Carboniferous guide foraminifera, corals and conodonts in the Franco-Belgian and Campine basins. Their potential for widespread correlation. Courier Forschungsinstitut Senckenberg, 130, 15-30.

Dorning, K.J (1981). Silurian acritarchs from the type Wenlock and Ludlow of Shropshire, England. Rev. Palaeobot. Palynol, 34, 175-203.

Dorning, K.J., Bell, D.G (1987). The Silurian carbonate shelf microflora: acritarch distribution in the