Testing the seasonal geochemical record of brachiopod shells: a case study from the Wuchiapingian of Iran

Marco Viaretti*†[1], Gaia Crippa[1], Giovanna Della Porta[1], Renato Posenato[2], and Lucia Angiolini[1]

[1]Università degli Studi di Milano = University of Milan – Italy
[2]Università degli Studi di Ferrara = University of Ferrara – Italy

Abstract

The Lopingian is represented by several sedimentary successions across Iran, most of them bearing rich fossil faunas, particularly brachiopods. As the tectonic setting of the region is very complex, consisting of an amalgamation of microplates sandwitched between the Arabian and Eurasian plates, correlation between these sedimentary successions may be difficult. Brachiopods, however, have been proven useful for correlations at a regional scale (Viaretti et al., 2021), who, based on the Unitary Association method, correlated the Hambast Formation at the Abadeh section in Central Iran with the Julfa Formation at the Ali Bashi Mountains Main Valley section in Julfa, Transcaucasia (Ghaderi et al., 2014).
As brachiopods are considered one of the best tools to investigate past conditions (e.g. Garbelli et al., 2022), a geochemical analysis has been performed on the brachiopod shells from the Abadeh section, with the aim of selecting the best brachiopod bioarchive. Specimens belonging to taxa with a laminar secondary layer (such as species of *Spinomarginifera, Araxilevis, Leptodus*) and taxa with a fibrous secondary layer (such as species of *Araxathyris, Transcaucasathyris, Rectambitus*) were analysed by SEM and cathodoluminescence (CL) and their oxygen and carbon isotope composition was measured. After diagenetic screening, *Araxilevis intermedius* (Abich, 1878) was shown to be the most suitable for geochemical analyses, since all the specimens belonging to other taxa were altered and/or too small to sample the shell avoiding contamination. The δ18O measured on all the brachiopod specimens also confirmed *A. intermedius* as the most reliable bioarchive. Considering these results, *A. intermedius* specimens from corresponding stratigraphic layers at Julfa were then selected and analysed by SEM and CL. The specimens from Julfa showed a better preservation of the shell microstructure compared to those from Abadeh. Most of the selected specimens possess a tertiary layer, and, except for one slightly luminescent specimen, the shells are non-luminescent.

The occurrence of large, thick and well-preserved shells in the two sections, confirmed by screening tests and published data as reliable bioarchives, offers the possibility to investigate in detail the palaeoclimate and palaeoenvironments of these Neotethys settings at low latitudes. The selected shells were then sampled with a sclerochronological approach, similar to that described by Garbelli et al. (2022), in order to investigate the occurrence of a seasonal pattern of δ18O and δ13C in the Wuchiapingian, a time interval which seems to record some

*Speaker
†Corresponding author: marco.viaretti@unimi.it

important changes and possibly a cooling before the end-Permian hothouse (e.g. Wang et al., 2020).

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