



## Early Changhsingian (Late Permian) ammonoids from NW Iran

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With 25 figures

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**Abstract:** Early Changhsingian ammonoids from the Transcaucasus-NW Iranian region are poorly known. Here we revise the ammonoids of this interval based on new findings in sections of the Aras Valley and Ali Bashi Mountains of the Julfa region, NW Iran. We revise the ceratitid genera *Phisonites*, *Iranites*, *Shevyrevites* and *Dzhulfites*. We introduce the new genus *Araxoceltites* with the three new species *A. sanestapanus*, *A. laterocostatus* and *A. cristatus*.

**Key words:** Late Permian, Ammonoidea, Iran, stratigraphy, diversity.

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### 1. Introduction

Late Permian (Lopingian) ammonoids are remarkable for their high overturn rates, which stand in contrast to the Early and Middle Permian, during which the group evolved considerably slowly on the substage and stage levels (e.g., MILLER & FURNISH 1940; RUZHENCEV 1952; RUZHENCEV 1956; LEONOVA 2002). The Late Permian is, after the end-Guadalupian extinction event that caused a significant extinction of the goniatitid ammonoids, characterized by the presence of ammonoid assemblages dominated by the order Ceratitida (e.g., RUZHENCEV 1962; RUZHENCEV 1963; ZHAO et al. 1978). Wuchiapingian ammonoid assemblages are dominated by members of the superfamily Otoceratoidea, while the Changhsingian assemblages are almost entirely composed of the superfamily Xenodiscoidea (e.g., RUZHENCEV & SHEVYREV 1965; ZHAO et al. 1978; LEONOVA 2002). During the Changhsingian, the otoceratids existed only as a ghost lineage (e.g., KUMMEL 1972). The abrupt change in the composition of ammonoid assemblages between the two stages has not been explained so far.

Early Changhsingian ammonoids are known in greater diversity from only two regions worldwide, the Transcaucasian-NW Iranian region and South China. However, while the South Chinese assemblages show

a high species richness, those from the Transcaucasus are comparatively poor. In their monograph describing the sections in Armenia and Azerbaijan, for instance, RUZHENCEV & SHEVYREV (1965) listed only eight xenodiscid species from this interval. This is in striking contrast to the late Changhsingian, from where alone nearly 30 species are known from the *Paratiro-lites* Limestone of NW Iran (KORN et al. 2016). A diversity analysis showed that the ammonoid diversity is increasing towards the top of the formation (KIESSLING et al. 2018).

During our field study of the Permian-Triassic boundary beds of NW Iran (Fig. 1), we measured and sampled several sections (Aras Valley, several parallel sections in the Ali Bashi Mountains, Zal) in great detail (applying bed-by-bed sampling) with the focus on petrography and microfacies characteristics (LEDA et al. 2014), conodont stratigraphy (GHADERI 2014; GHADERI et al. 2014b; ISAA et al. 2016), stable isotopes (SCHOBEN et al. 2014; SCHOBEN et al. 2015; SCHOBEN et al. 2016; SCHOBEN et al. 2019), brachiopods (GHADERI et al. 2014a) and ammonoids (GHADERI et al. 2014b; KORN et al. 2016). Within this multidisciplinary project, we also collected a number of ammonoids from the early Changhsingian Zal Member of the Ali Bashi Formation, which are described below.