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The Ediacaran–Cambrian and Ordovician rocks of Al Qasim Province, Saudi Arabia: Facies, depositional history and regional correlation

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ABSTRACT

In the Al Qasim region, Saudi Arabia, Ediacaran to Lower Cambrian facies are represented by polymictic conglomerates that occur locally in channels formed by the Najd fault system. The Middle–Upper Cambrian–Ordovician succession is exposed along the western margin of the Arabian Basin in the Al Qasim region, and is represented by the Middle–Upper Cambrian Saq Formation and the Lower Ordovician Anz Formation. The Saq Formation consists of two lithologic units. The lower unit comprises massive, trough and low-angle cross-bedded sandstones and siltstone–mudstone channel layers. It is interpreted as channel facies, probably deposited in a fluvial or estuarine environment. The upper unit of the Saq Formation includes sandy siltstone and bioturbated thin-bedded and rippled sandstone with the ichnogenus *Cruziana* and vertical burrows such as *Skolithos*. The Anz Formation consists of thin-bedded, bioturbated and laminated sandstones intercalated with bedded siltstone to mudstone. Siliceous (silicified) lithoclastic sandstone occurs at the top. These facies indicate coastal and shallow intertidal environments. The Anz Formation contains different ichnospecies of *Cruziana*, e.g., *Cruziana cf.*, *C. furcifera*; *C. huberi* and *C. goldfussi*. These fossils are indicative of Early Ordovician age and can be used for correlation with the adjacent countries. Both the Saq and the Anz Formations were eroded in some areas by the glacial movement of the overlying Lower Ordovician–Lower Silurian Zarqa and Sarah formations. Sedimentation occurred on a wide shelf on a passive margin with low accommodation.

1. Introduction

The Cambro-Ordovician rocks make a laterally continuous sandstone blanket covering the northern margin of the Gondwanaland (Powers et al., 1966; Selley, 1972; Wolfart, 1983; Sharland et al., 2001, 2004). Such sandstones are overlain by the marine shales with graptolites of the Llandovery age (Selley, 1972). The Cambro-Ordovician rocks are subdivided into two main units. The lower unit consists of coarse-grained cross-bedded pebbly sandstone with rare trace fossils. This unit includes the Saq Formation in Saudi Arabia (Powers et al., 1966; Vaslet, 1987a), the lower Araba Formation in Egypt (Khalifa et al., 2006), the Saleb, Umm Ishrin and Disi formations in Jordan (Lloyd, 1968; Selley, 1972), the Hasawnah Formation in Libya (Massa and Collomb, 1960), and unit II of Algeria (Bennacef et al., 1971) (Table 1). The upper unit comprises fine-grained, bioturbated and well-sorted sandstone, enriched with Tigillites (*Skolithos* burrows) and trilobite trace fossils and includes the *Cruziana* Series of Saudi Arabia (Helal, 1964, 1965, 1968), the Anz Formation in Saudi Arabia (Khalifa, 1993), the Umm Sahm Formation in Jordan (Lloyd, 1968; Selley, 1972; Bender, 1974), the upper Araba Formation in Egypt (Khalifa et al., 2006), the Achebyat and Haouaz formations in Libya (Massa and Collomb, 1960) and unit III of Algeria (Bennacef et al., 1971) (Table 1).

The Cambro-Ordovician rocks in Saudi Arabia are exposed as a great curved belt dipping gently northeastwards around the Arabian Shield and unconformably overlie the Precambrian basement rocks (Fig. 1). Powers et al. (1966) studied the Cambro-Ordovician rocks in the central part of Al Qasim Province and attributed the lower part of the Saq Formation to the Cambrian and the upper part of the Saq Formation to the Early Ordovician (Fig. 2). The term Siq Sandstone was introduced later north of Saudi Arabia near the Jordanian border. It unconformably underlies the Saq Formation and has been assigned to Ediacaran–Cambrian to Early Cambrian age (Bramkamp et al., 1963). Its type section lies outside the study area, just northwest of lat. 28°N, and long. 36°E, about 25 km east of Sh'ib al Siq, where its maximum thickness (30 m) was detected (Bramkamp et al., 1963).

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Table 1
General correlation of the Cambro-Ordovician rocks in Saudi Arabia and the adjacent countries.

Age	Saudi Arabia (Khalifa, 1993)	Jordan (Selley, 1972)	Egypt (Khalifa et al., 2006)	Libya (Massa and Collomb, 1960)	Algeria (Bennacef et al., 1971)
Ordovician	Anz Formation or Cruziana Series	Umm Sahm Formation	Upper part of the Araba Formation	Achebyat and Haouaz formations	Unit 111
Cambrian	Saq Formation	Umm Ghaddah, Saleb, Abu Khusheiba (Burj Limestone), Ishrin and Disi formations	Lower part of the Araba Formation	Hasawnah Formation	Unit 11

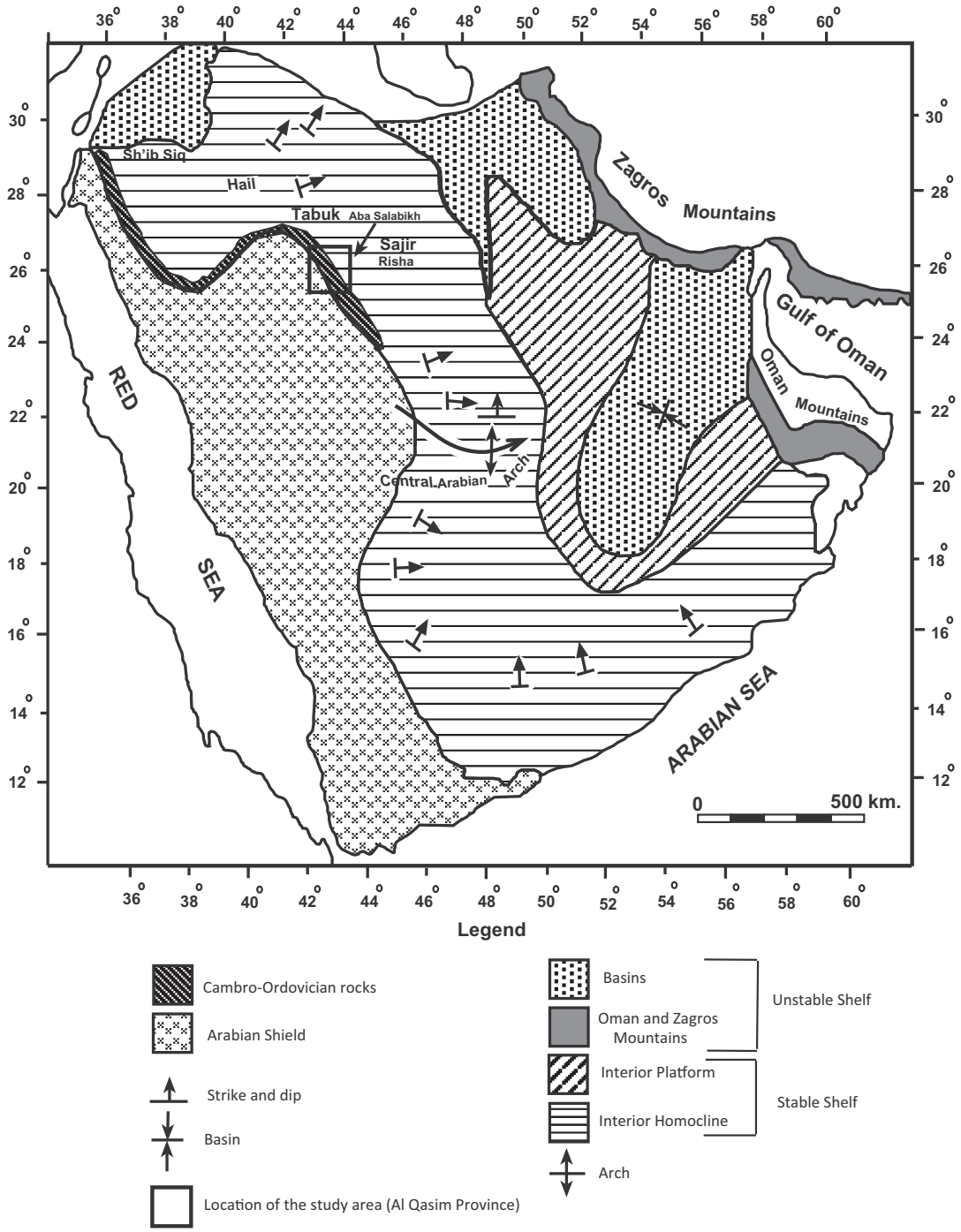

Fig. 1. Tectonic map of the Arabian Plate on which the general distribution of the Cambro-Ordovician rocks is illustrated (modified from Powers et al., 1966).