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Subsidence and drowning of a carbonate platform in south-central Mongolia (Gobi Altai region) during the late Eifelian to early Givetian: A synthesis of conodont data, magnetic susceptibility, and paleoecology

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ABSTRACT

New and published stratigraphic data are integrated herein to resolve the age and depositional setting of Middle Devonian strata in the Gobi-Altai Terrane of south-central Mongolia (Bayanhongar Province). The Tsagaankhaalga Formation (Emsian?–Eifelian) is composed primarily of tabular sandy carbonates; it is sharply overlain by dark, fine-grained volcanoclastic marine sedimentary rock of the Govialtai Formation (Givetian), which is comparatively unfossiliferous, except for sporadic, fossiliferous carbonate interbeds. The latter unit contains abundant tentaculites as well as a newly recovered collection of conodonts assigned to the lower Givetian *varcus* Zone (*timorensis*, *rhenana*, or *ansatus*). A positive shift in bulk magnetic susceptibility coincides with the Tsagaankhaalga/Govialtai contact, and elevated values within the Govialtai correspond to tuffaceous and rhyolitic strata.

The transition from carbonate facies of the Tsagaankhaalga Formation to the volcanoclastic shales of the Govialtai Formation is interpreted as the result of local tectonic activity. This may be qualitatively described as a transition from a shallow marine carbonate shoal with an epibenthic fauna (Tsagaankhaalga), to a deeper, clastic dominated environment with a nektic fauna (Govialtai). The pulse of tectonism must predate the lower Givetian, and it echoes the "Tsakhir Event", which is recorded by the transition from Ordovician–Silurian carbonates to Lochkovian conglomerate. These findings provide useful biostratigraphic control and insight into the complex tectonic evolution of the Gobi-Altai Terrane and adjacent blocks on the Eurasian Craton.

1. Introduction

Extensive successions of Middle Devonian sedimentary rock exposed in south-central Mongolia constitute an important record of the history and evolution of the tectonically complex central Eurasian craton. However, this resource is difficult to utilize, owing to its remote setting. Although previous studies have greatly constrained the age and depositional environments of these strata, the degree of stratigraphic refinement has yet to attain the resolution achieved in well-studied sedimentary basins elsewhere in the world (e.g. Brett et al., 2011; Ellwood et al., 2011; Becker et al., 2012; Gouwy et al., 2013).

This report presents new conodont biostratigraphic data, a magnetic susceptibility curve, and observations of facies for the uppermost Tsagaankhaalga Formation and the lower Tentaculite Member of the Govialtai Formation at exposures near the Tsakhir Well, located approximately 20 km southeast of Shine Jinst in the Bayanhongar Province (Figs. 1 and 2). Although these units have been studied on several occasions by joint Russian, Mongolian, and Chinese expeditions (see Webby and Talent, 2001 – and references therein) much uncertainty surrounds their age, depositional environments, and tectonic setting. New and published information, synthesized herein, are used to constrain the age of the Govialtai Formation, document tectonically driven subsidence, and investigate prevailing ecological conditions that held sway as these strata were deposited. These findings may shed light on the depositional history and tectonic evolution of central Asia and contribute to a more complete understanding of the Middle Devonian world.

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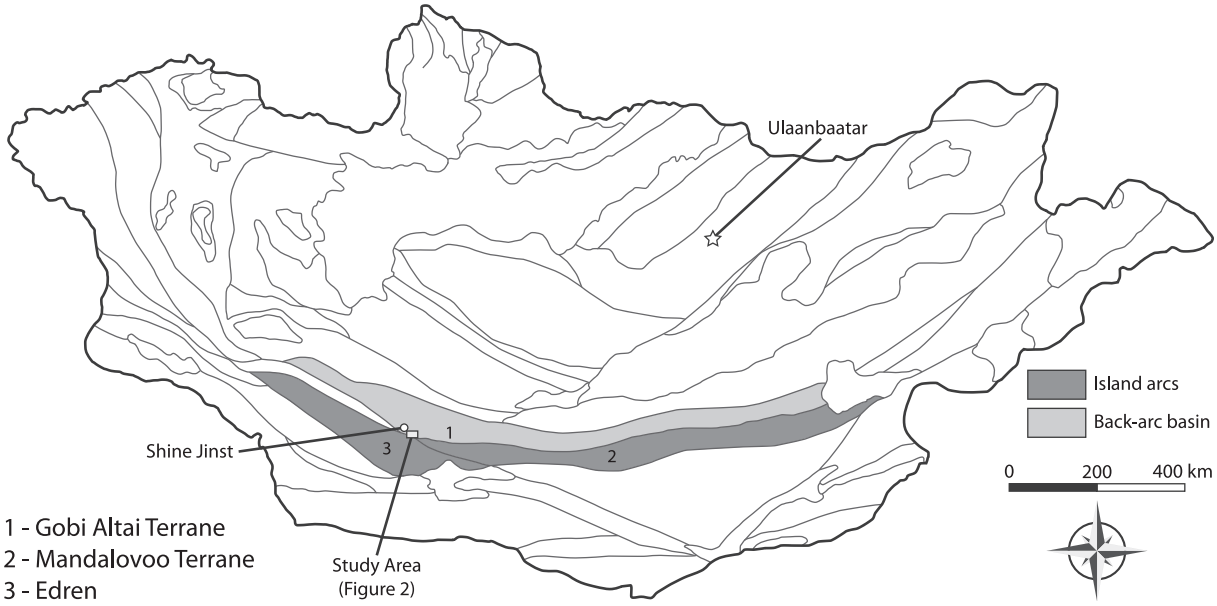

Fig. 1. Tectonostratigraphic map of Mongolia with the Gobi-Altai (light gray), Mandalovoo, and Edren (dark gray) terranes highlighted (modified from Bardarch et al. (2002)). The Gobi-Altai terrane has been interpreted as a back-arc basin formed behind volcanic island arcs (represented by the Mandalovoo and Edren terranes). A detailed map of the study area is shown in Fig. 2.

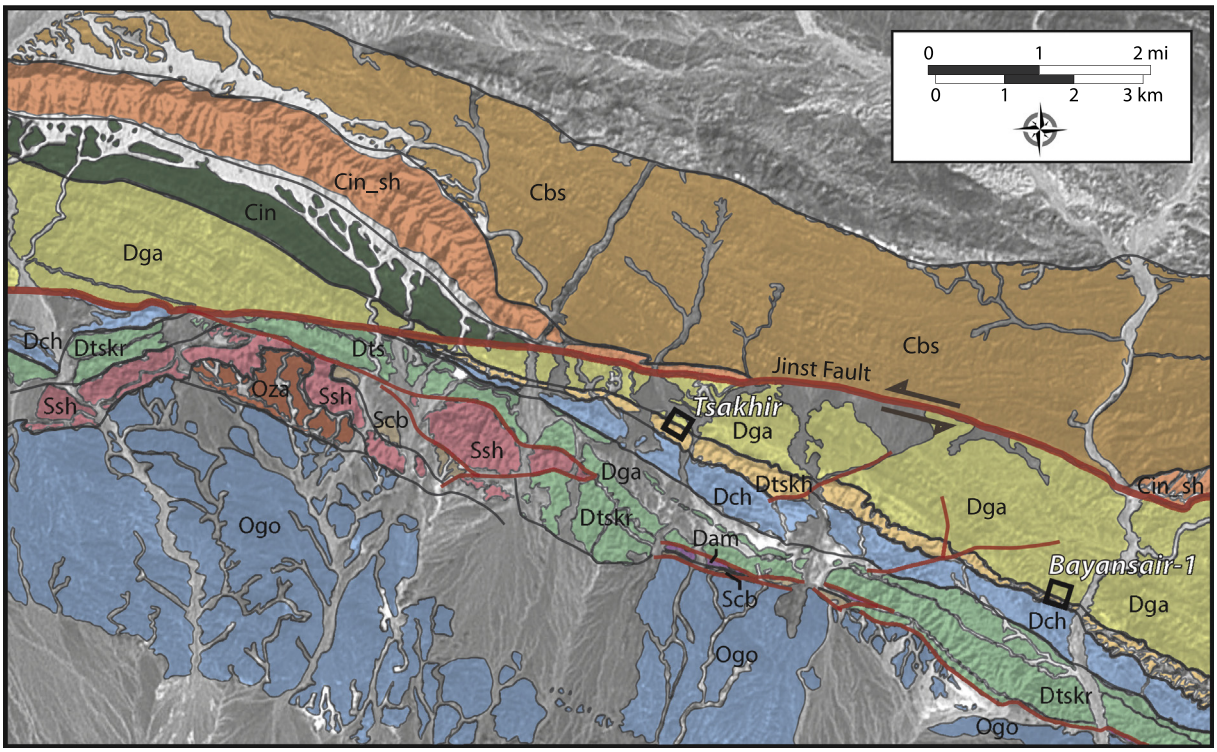

Fig. 2. Bedrock geologic map of stratigraphic bedrock superimposed on a landsat image of the study area near Shine Jinst, Mongolia. Original aerial photo is from Google Earth (2014). Geologic map units have been modified from Minjin et al. (2001), Lamb et al. (2008), and Gibson et al. (2013). The study section analyzed here (Tsakhir) and the designated type section for the Govialtai Formation (Bayansair-1) are both identified by black boxes.

2. Geologic setting

The outcrops forming the basis of this study are situated in the northern Gobi Desert near the eastern extremity of the Altai Mountains. This area is located within the Gobi-Altai Zone, a large, east–west trending structural province bounded to the north by the main Mongolian lineament and to the south by the Trans-Altai Fault (Zorin et al., 1993; Kröner et al., 2010). Paleozoic bedrock near Shine Jinst is marked by steeply dipping northwest–southeast trending sedimentary and volcanic strata cross cut by numerous regional faults (Fig. 2; Tikhonov and Yarmolyuk, 1982; Lamb et al., 2008).

The bedrock of Mongolia consists of numerous, discrete terranes that have accreted in east–west trending arcs onto small