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Upper Jurassic–Lower Cretaceous stratigraphy in south-eastern Tibet: a comparison with the western Himalayas

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Abstract

Lithostratigraphic studies of the Upper Jurassic–Lower Cretaceous sedimentary successions exposed in the Tingri–Gyangze area, south-eastern Tibet resulted in the establishment of a revised stratigraphic framework. A major crustal fault separates the southern Tibetan sedimentary successions into a Southern Zone and a Northern Zone. The Upper Jurassic–Lower Cretaceous strata of the Southern Zone are subdivided into the Menkadun Formation (Oxfordian, Kimmeridgian, up to lower Upper Tithonian), the Gucuo Formation (Upper Tithonian to Lower Albian) and the overlying Dongshan Formation (Upper Albian). The Gucuo Formation is further subdivided into a quartz arenite unit, which is overlain by a shale unit, in turn overlain by a volcaniclastic sandstone unit. The youngest cluster of detrital zircon absolute age data (127.7 ± 1.8 Ma) from the lower part of the volcaniclastic unit of the Gucuo Formation place the volcanic event before the Late Barremian.

In the Northern Zone, the Upper Jurassic–Lower Cretaceous strata have been subdivided into four formations: the Zhera Formation (Upper Jurassic), the Weimei Formation (Tithonian), the Rilang Formation (?Berriasian) and the Gyabula Formation (? post-Valanginian).

The appearance of silica cemented quartz arenites in both the quartz arenite unit of the Gucuo Formation and the Weimei Formation in the uppermost Jurassic is considered to provide strong evidence for an eustatic sea level drop affecting the northern margin of Greater India. In contrast the appearance of volcaniclastic sandstones in the Gucuo and Rilang formations are interpreted to represent a rift related volcanic event.

The Menkadun–Zhera formations, the quartz arenite unit of the Gucuo Formation–Weimei Formation, the volcaniclastic sandstone unit–Rilang Formation in south-eastern Tibet are lithologically similar and broadly correlative with the Spiti Shale, Takh and Pingdon La formations in Zanskar (India), and Spiti Shale, Dangardzong, Kagbeni and Dzong formations in the Thakkhola area (Nepal). The onset of quartzose and subsequently volcaniclastic deposition becomes progressively younger westward, from the Gucuo region toward Zanskar.

Keywords: Stratigraphy; South-eastern Tibet; Tethys Himalaya; Lower Cretaceous; Upper Jurassic

1. Introduction

Mesozoic sedimentary strata deposited on the northern Greater India continental margin crop out in the Tethys Himalayas, along the whole length of the Himalayan mountain chain, from Ladakh in the west to south-eastern Tibet (Fig. 1). Detailed studies of the Mesozoic sedimentary strata were mostly carried out in the western Himalayas (Gansser, 1964; Fuchs, 1982; Gaetani et al., 1986; Gaetani and Garzanti, 1991; Bhargava and Bassi, 1998; and references cited therein). Later, the interest has increasingly focused on the Mesozoic sedimentary strata in the Thakkhola region of the central Himalayas (Bordet et al., 1967, 1971, 1975; Garzanti and Pagni Frette, 1991; Gradstein et al., 1989, 1991; Gibling et al., 1994. Nagy et al., 1995), in an attempt to investigate the tectonic evolution of the conjugated margins of northern Greater India (Powell et al., 1988; Gradstein and von Rad, 1991). It was found that Jurassic and Lower Cretaceous sedimentary successions in central Nepal have many similarities with the strata drilled by the Ocean Drilling Project (ODP)

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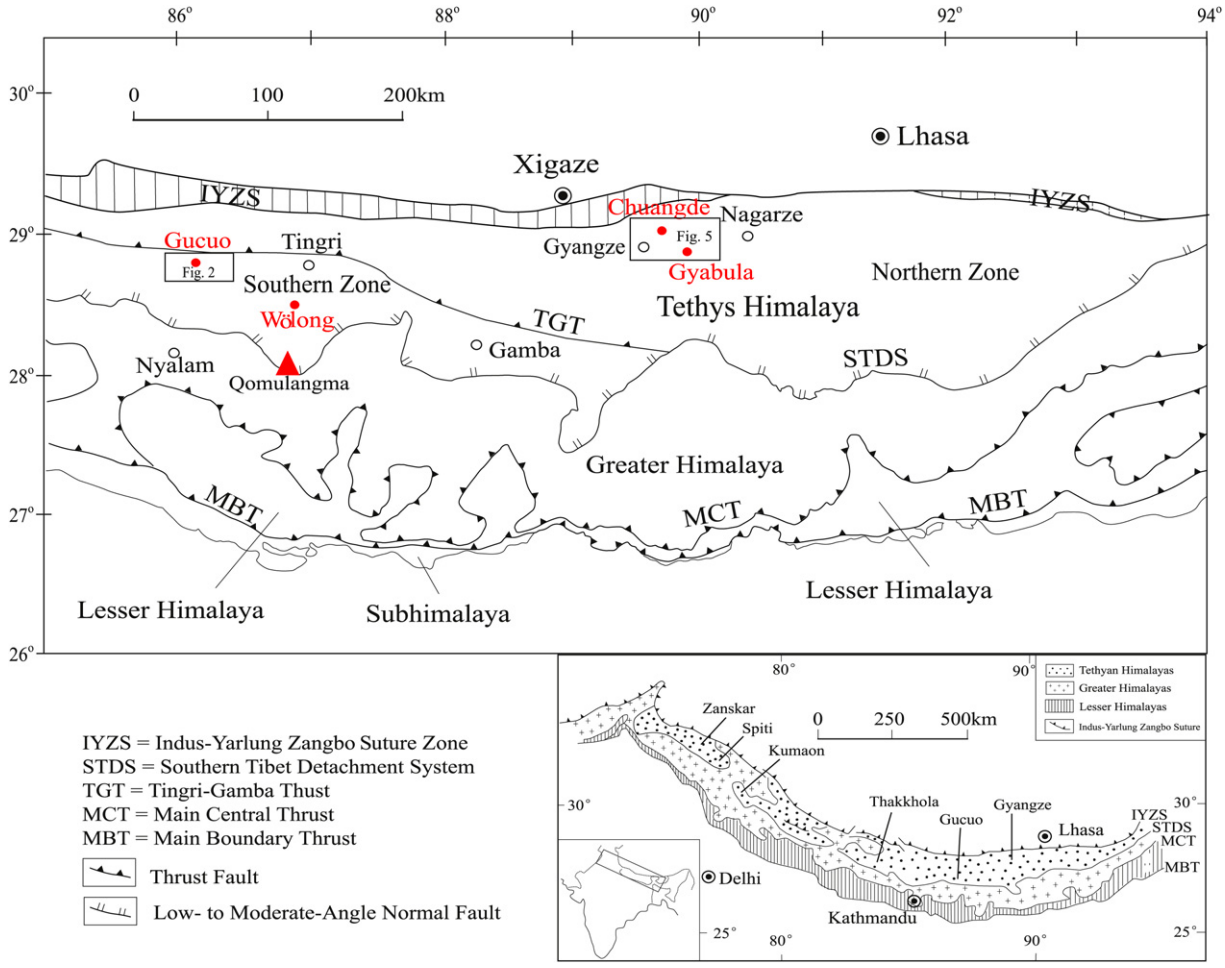

Fig. 1. Sketch geological map of the central Himalayas showing the tectonic setting and location of studied sections – the Gucuo, Chuangde and Gyabula sections; and the Wölong section investigated by Jadoul et al. (1998).

off north-western Australia (Gradstein and von Rad, 1991; Gibling et al., 1994). Later, several studies were published comparing the Mesozoic sedimentary strata of southern Tibet with the coeval strata cropping out in northern central Nepal (Garzanti et al., 1998; Jadoul et al., 1998).

In southern Tibet (Fig. 1) Upper Jurassic–Lower Cretaceous strata were studied predominantly in the Gucuo area, located west of Old Tingri and in the Gyabula area east of Gyangze. These studies were mainly biostratigraphic. The ammonite fauna was studied by Liu (1983, 1988), Liu and Wang (1987), Yin and Enay (2004), the bivalves by Yao et al. (1991), Li and Grant-Mackie (1994), Gou (1985, 1997), and the belemnites by Yin (1975). No detailed lithostratigraphic and sedimentological studies of the Upper Jurassic–Lower Cretaceous strata were published from the above areas. During the last ten years, we have made six field expeditions into the Tingri–Gyangze area to study the Mesozoic sedimentary strata, their compositions and depositional evolutions.

A major difficulty encountered during this study is the general scarcity of fossils, including microfossils, in the Lower Cretaceous sedimentary strata, hindering precise biostratigraphic dating. The other difficulty emanates from the intensive tectonic deformation and faulting of the region, so providing rarely tectonically undisturbed sedimentary successions. Lithostratigraphy has been used to establish a stratigraphic framework for the studied areas and for inter-regional correlation. This approach revealed several disagreements between biostratigraphic ages and ages derived from regional lithostratigraphic correlations and isotopic absolute age determination.

The results of our stratigraphic studies of the Upper Jurassic–Lower Cretaceous strata cropping out in south-eastern Tibet are presented. The correlation of Upper Jurassic–Lower Cretaceous strata between the western and eastern Himalayas is also discussed.

2. Geologic setting

Mesozoic sedimentary rocks are exposed in the Tibetan Tethyan Himalayas between the Greater Himalayas and the Indus–Yarlung Zangbo Suture (Gansser, 1964; Wang et al., 1996; Yin and Harrison, 2000) (Fig. 1). They were deposited along the Greater India continental margin, which was part of the Pangaea supercontinent (Powell et al., 1988; Patzelt et al., 1996).

Deposition on the margin began during the Late Palaeozoic (Gaetani and Garzanti, 1991; Garzanti, 1999) and continued