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From rift to drift in South Pamir (Tajikistan): Permian evolution of a Cimmerian terrane

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ABSTRACT

Here, we describe the Permian–Lower Triassic sedimentary succession of South Pamir and the associated biota of conodonts, foraminifers and brachiopods. The studied succession comprises the Carboniferous-Lower Permian siliciclastic Uruzbulak and Tashkazyk formations (Bazar Dara Group), which are unconformably covered by upper Lower to Upper Permian units, deposited both in platform settings (Kurteke Formation), and on the slope and basin (Kochusu Formation, Shindy Formation, Kubergandy Formation, Gan Formation, and Takhtabulak Formation). These formations comprise bioclastic limestones, cherty limestones, shales, volcaniclastic rocks, basalts, sandstones and conglomerates, and are locally very rich in fossils (fusulinids, ammonoids, brachiopods, corals and conodonts). The Permian succession is then overlain by shallow water carbonates of the Induan to Anisian Karatash Group. Subsidence analysis and volcanics of the Permian and overlying Triassic successions constrains the timing of rifting of South Pamir from Gondwana in the Early Permian (=Cisuralian), and its docking to Central Pamir, the Eurasian margin and the interposed volcanic arcs at the end of the Triassic. The sedimentary successions of the Pamirs represent a key-point to refine the correlations between the Tethyan regional scale and the International Time Scale. The analyses of the fusulinids and conodonts of the Kubergandian and Murgabian stratotypes of SE Pamir suggest that: (1) the upper Bolorian and the lower part of the Kubergandian correlate to the upper Kungurian; (2) the upper Kubergandian and the lower Murgabian correlate to the Roadian; (3) the mid-upper Murgabian correlates to the Wordian; (4) possibly the uppermost Murgabian and the lower Midian correlate to the lower Capitanian.

The Kubergandian is thus a defined regional stage, based on fusulinids, ammonoids and conodonts and can be correlated to the Kungurian and the Roadian; still problematic remains the Murgabian correlation which needs to be investigated and resolved in other Tethyan sections.

1. Introduction

The tectonic setting that characterizes nowadays Central Asia is the results of a complex evolution that started at the beginning of the Mesozoic with the progressive accretion of several blocks of Perigondwanan ancestry to the Eurasian margin and the closure of the Palaeotethys ocean by subduction beneath the southern Eurasia margin (Zanchetta et al., 2013 and references therein). This geodynamic event, traceable from Iran to Tibet through Central Asia, is known as Cimmerian orogeny and it is bracketed in time between the Late Triassic and the Early Jurassic (e.g. Sengör, 1979; Gaetani, 1997; Schwab et al., 2004; Zanchi et al., 2009; Zanchi and Gaetani, 2011; Robinson et al., 2012; Angiolini et al., 2013a, 2013b). However, the events leading to this complex tectonic evolution started much earlier than the Mesozoic, in the Late Carboniferous-Early Permian. This time witnessed the progressive distinction and detachment of the Cimmerian terranes – including Iran, Central Afghanistan, Karakorum, Central and South Pamir, and Sibumasu – which broke off from the Gondwanan margin and drifted northward with the opening of the Neotethys Ocean (Sengör, 1979; Gaetani, 1997; Angiolini et al., 2003, 2007; Muttoni et al., 2009; Domeier and Torsvik, 2014).

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South Pamir, one of the main orogenic belts which form the Pamirs (e.g. Yin and Harrison, 2000; Schwab et al., 2004; Robinson et al., 2012; Angiolini et al., 2013a) (Fig. 1), results from the Late Triassic collision of a Cimmerian block- broken off the Gondwanan margin in the Early Permian- with Central Pamir. This in turn was colliding with the southern Eurasian margin and the interposed volcanic arcs (Karakul-Mazar belt) at the end of the Triassic (Cimmerian orogeny) (e.g. Sengör, 1979; Gaetani, 1997; Schwab et al., 2004; Zanchi et al., 2009; Muttoni et al., 2009; Zanchi and Gaetani, 2011; Robinson et al., 2012; Angiolini et al., 2013a, 2013b). The South Pamir belt was later deformed during the Mesozoic and finally during the Caenozoic by collision and indentation of India (Burtman and Molnar, 1993; Replumaz et al., 2014).

Understanding the Permian-Triassic evolution of South Pamir is thus very important to add further constraints on the differential motions of the Cimmerian terranes at the Palaeozoic-Mesozoic transition.

If considerable efforts were done so far to reconstruct the palaeobiogeographic affinity, the tectonic deformation and the timing of accretion of South Pamir to Eurasia (e.g. Dronov and Leven, 1990; Vlasov et al., 1991; Schwab et al., 2004; Robinson et al., 2012; Angiolini et al., 2013a), less information is available on its sedimentary evolution during Permian and on the tempo of its detachment from Gondwana and early northward drift. This information is recorded in the sedimentary successions spectacularly cropping out in the Gorno-Badakhshan Autonomous Region of Southeast Pamir, Tajikistan (hereafter SE Pamir) (Fig. 1).

The goal of this paper is to document in detail the stratigraphic evolution of the Upper Palaeozoic sedimentary basins of the South Pamir terrane, and, through subsidence analysis, to constrain the timing of its rifting from the Gondwana margin and the subsequent drifting during Permian.

The sedimentary succession of SE Pamir represents also a key-point to refine the correlations between the Tethyan chronostratigraphic scale and the International Time Scale. Therefore, this paper is also aimed to contribute to the discussion on the Middle Permian (=Guadalupian) correlation, hotly debated by the Subcommission on Permian Stratigraphy of the International Commission on Stratigraphy, IUGS.

2. Geological setting

South Pamir is separated from Central Pamir by the Rushan-Pshart zone (Pashkov and Budanov, 1990; Leven, 1995; Burtman, 2010; Robinson et al., 2012; Angiolini et al., 2013a). South Pamir is bounded southward by Karakoram, but their contact is still debated, some authors considering them to be continuous (e.g. Schwab et al., 2004; Robinson et al., 2012); others authors (Zanchi et al., 2000; Zanchi and Gaetani, 2011) seek for a minor suture zone along the Tirich Boundary Zone (TBZ) where serpentinized mantle peridotites may represent the remnants of a secondary suture zone (Fig. 1). The southwestern part of South Pamir consists of metamorphic rocks exhumed in the Cenozoic following the Indian plate collision (Schmidt et al., 2011; Stübner et al., 2013a, 2013b). The southeastern region of South Pamir, i.e. SE Pamir, shows a thick Permian to

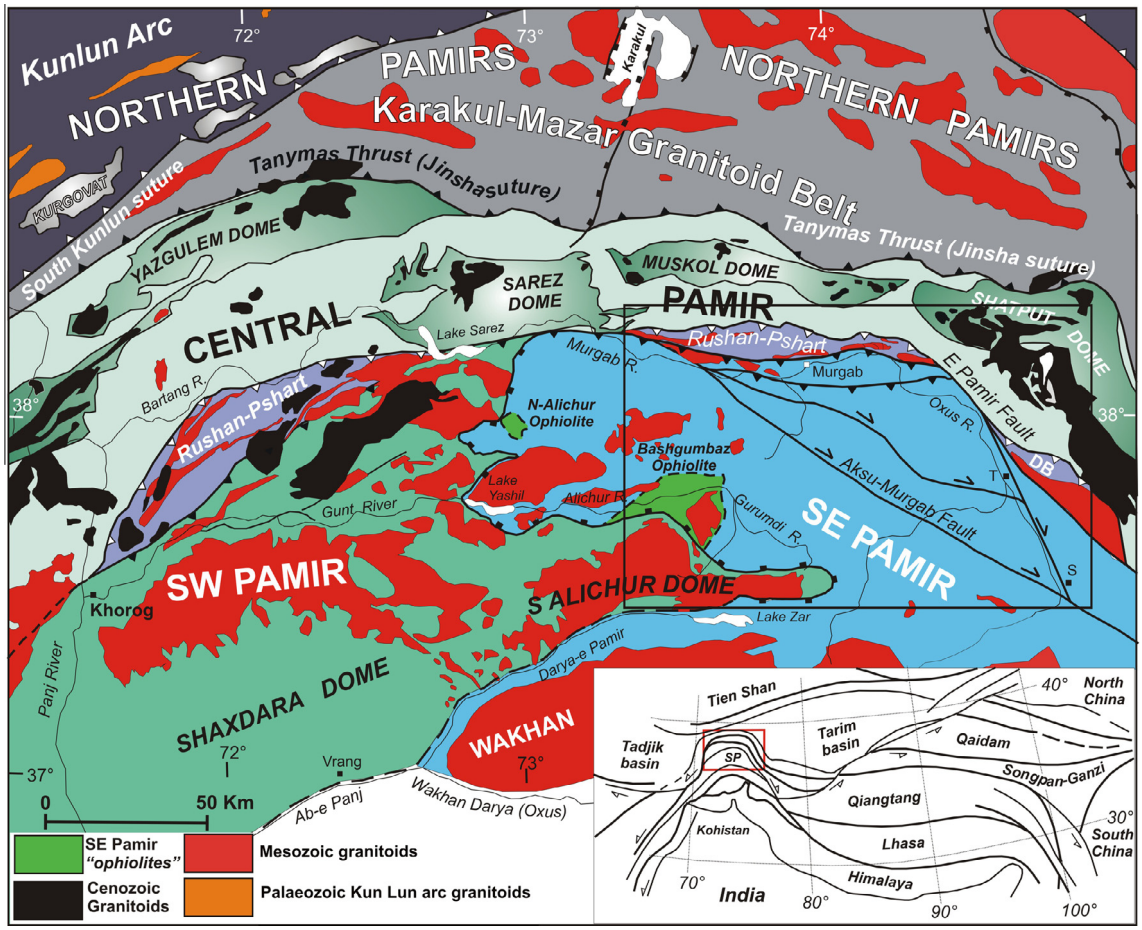

Fig. 1. Tectonic setting of SE Pamir, C Pamir and N Pamir, located between the Eurasian plate to the north and the Karakorum, Kohistan/Ladakh and the Indian plate to the south. The studied area is outlined in red. KKSZ: Karakoram–Kohistan suture zone; MMT: Main mantle thrust. Modified from Angiolini et al. (2013a) (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.).