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Tethyan and Indian subduction viewed from the Himalayan high- to ultrahigh-pressure metamorphic rocks

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Abstract

The Himalayan range is one of the best documented continent-collisional belts and provides a natural laboratory for studying subduction processes. High-pressure and ultrahigh-pressure rocks with origins in a variety of protoliths occur in various settings: accretionary wedge, oceanic subduction zone, subducted continental margin and continental collisional zone. Ages and locations of these high-pressure and ultrahigh-pressure rocks along the Himalayan belt allow us to evaluate the evolution of this major convergent zone.

(1) Cretaceous (80–100 Ma) blueschists and possibly amphibolites in the Indus Tsangpo Suture zone represent an accretionary wedge developed during the northward subduction of the Tethys Ocean beneath the Asian margin. Their exhumation occurred during the subduction of the Tethys prior to the collision between the Indian and Asian continents.

(2) Eclogitic rocks with unknown age are reported at one location in the Indus Tsangpo Suture zone, east of the Nanga Parbat syntaxis. They may represent subducted Tethyan oceanic lithosphere.

(3) Ultrahigh-pressure rocks on both sides of the western syntaxis (Kaghan and Tso Morari massifs) formed during the early stage of subduction/exhumation of the Indian northern margin at the time of the Paleocene–Eocene boundary.

(4) Granulitized eclogites in the Lesser Himalaya Sequence in southern Tibet formed during the Paleogene underthrusting of the Indian margin beneath southern Tibet, and were exhumed in the Miocene.

These metamorphic rocks provide important constraints on the geometry and evolution of the India–Asia convergent zone during the closure of the Tethys Ocean. The timing of the ultrahigh-pressure metamorphism in the Tso Morari massif indicates that the initial contact between the Indian and Asian continents likely occurred in the western syntaxis at 57±1 Ma. West of the western syntaxis, the Higher Himalayan Crystallines were thinned. Rocks equivalent to the Lesser Himalayan Sequence are present north of the Main Central Thrust. Moreover, the pressure metamorphism in the Kaghan massif in the western part of the syntaxis took place later, 7 m.y. after the metamorphism in the eastern part, suggesting that the geometry of the initial contact between the Indian and Asian continents was not linear. The northern edge of the Indian continent in the western part was 300 to 350 km farther south than the area east of the Nanga Parbat syntaxis. Such "en baionnette" geometry is probably produced by north-trending transform faults that initially formed during the Late Paleozoic to Cretaceous Gondwana rifting. Farther east in the southern Tibet, the collision occurred before 50.6±0.2 Ma. Finally, high-pressure to ultrahigh-pressure rocks in the western Himalaya formed and exhumed in steep subduction compared to what is now shown in tomographic images and seismologic data.

Keywords: Himalaya; HP-UHP metamorphic rocks; Subduction; India–Asia collision

1. Introduction

Since the first petrological description of eclogites by Hauÿ (1822), eclogites have been reported from many locations with

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