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THE OPHIOLITE BELTS AND SUTURE TRACES IN PAKISTAN

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ABSTRACT

The paper deals with the four ophiolite belts as indicated by the occurrences of ultramafic rocks, pillow lavas, greenschists, pyroclasts and basaltic flows. Of these four belts, three are indicative of suture zones while one is related with a deep fracture through which ultramafic magma alongwith other types has intruded.

INTRODUCTION

The geological and tectonic maps of Pakistan reveal that it is a meeting point of five major and minor plates and can be a key position for the study of plate tectonics in the region (Fig. 1). In this paper the ophiolite belts as indicated by the ultramafic and other rocks have been described and their relation with suture lines have been discussed.

Ophiolite Belts and Their Tectonic Position

Ophiolites generally occur along the suture zones between two plates, however, sometimes deep fissures, through which even the ultramafic magma could rise up, are also marked by ophiolitic rocks. A glance on the geological map of Pakistan shows that there are four independent belts of ultramafic rocks of various extension in Pakistan (Fig. 1). They can be grouped as follows :

I. Las Bela-Zhob-Waziristan-Malakand-Chilas-Raikot-Haramosh-Kishan Ganga-Titwal belt;

II. Nal-Jabi belt;

III. Ras Koh Range belt; and

IV. Makran-Chaman-Lora Rud-Gardez-Chitral-Yasin-Karakoram belt.

It is contemplated that these ophiolite belts (except the last) are indicative of three separate suture zones which seem to occur between the following pairs of blocks or small sub-plates (Fig. 1).

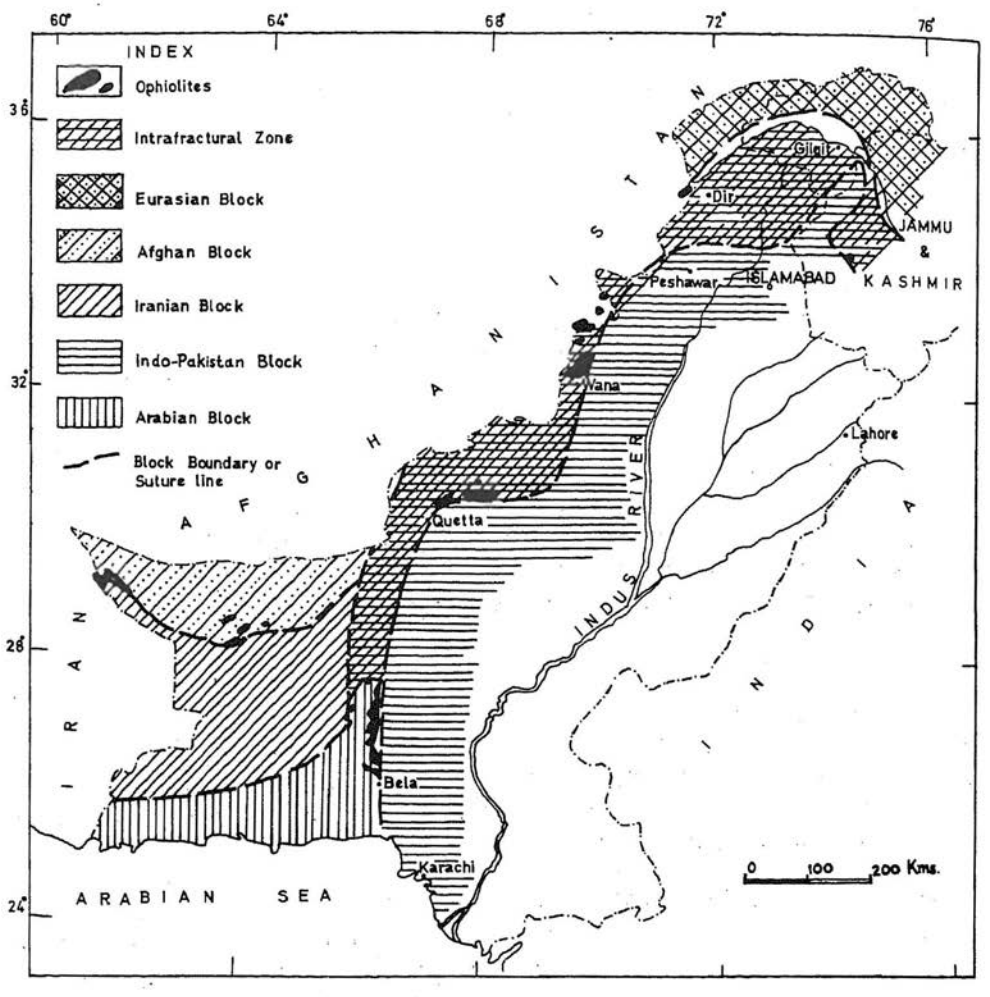

Fig. 1. Map showing the ophiolite belts and suture traces in Pakistan.

1. Arabian + Indo-Pakistan blocks
2. Arabian + Iran blocks
3. Iran + Afghanistan blocks
4. Iran + Indo-Pakistan blocks
5. Afghanistan + Indo-Pakistan blocks
6. Indo-Pakistan + Eurasian blocks

These blocks essentially have different structural grains, consolidation, and geological history, which have been discussed to some extent by Sokolov and Shah (1966).

I. Las Bela-Zhob-Waziristan-Malakand-Chilas-Raikot-Kishan Ganga-Titwal belt.

This belt is the most extensive and runs regularly from Las Bela to Raikot. Its further alignment is disturbed by the protrusion of Nanga Parbat-Haramosh block and its swing along the eastern flank of the block upto Titwal is somewhat conjectural. The ophiolites outcrop along the margins of the Indo-Pakistan plate with those of Arabian, Iranian, Afghanistan, Kohistan and Eurasian blocks. Ultramafic rocks outcrop from east of Bela upto north of Khuzdar (more than 150 km. along the suture). The ultramafics mostly occur in the form of relatively small basic sills, flows, pillows with radiolarian chert, agglomerates and other fine pyroclastics mixed with cherty and green shale-like material. Between Bela and Zhob small isolated outcrops of mafic and ultramafic rocks are seen scattered within the width of the belt. Chromite mineralization is only sporadic in this part of the belt.

The ophiolites of Zhob valley (Bilgrami, 1968) and Waziristan (Jan et al., 1983) are rich in chromite. The intrusives comprise of mafic and ultramafic rocks, while the volcanics include basaltic lavas, pillows, dykes, tuff, agglomerate, and volcanic ash. These are associated with shales, chert, carbonates and greenschists.

Further north the ophiolite of Harichand, rich in chromite, outcrops discontinuously for a distance of more than 45 km (Rafiq, 1984), and is emplaced into greenschists (Ahmed, 1978). It is considered to be a klippe by Tahirkheli *et al.* (1979).

Ultramafic and related rocks also occur at Jijal, Chilas, Raikot, and a number of other localities along Karakoram Highway, and are reported mostly to be ophiolitic in character (Bard *et al.*, 1980; Jan, 1980). On the eastern flank of Nanga Parbat-Haramosh loop, pods of ultramafic rocks are seen in Skardu and Deosai area extending southwards into the Kashmir valley. These bodies are conjectured to align with those found near Titwal.

II. Nal-Jabi Belt.

It starts in the form of a small intrusion in the north of Nal area and extends south-southwestwards (between Arabian and Iranian blocks). Its outcrop pattern shows as if the Las Bela zone has taken a curve in Nal area along some burried wedge and follows a course in harmony with the Khuzdar syntaxis. Further west the belt is in alignment with ophiolites on the Iranian side of the border.

III. Ras Koh Range Belt.

The ultramafics here are chromite-bearing and in some cases nodular chromite outcrops in the country rocks entirely independent of ultramafic rocks. The ultramafic rocks occur in the form of sills near Koh-e-Malik close to the meeting point of Pakistan-Iran-Afghanistan borders. The sills extend east-south-westwards upto northeast of Juzzak village. However, spot checks in the field and their petrological examination in the laboratory indicate that they have intermediate composition and may not belong to the ophiolite suite.

At the point of truncation of the Ras Koh range by the Chaman fault, it is suspected that the Ras Koh ophiolites join the belt of igneous rocks outcropping along Chaman fault ranging in composition from acid to ultrabasic. The author, however, considers that the Chaman fault zone is of independent occurrence. It is quite likely that the Chaman fault being a very deep-seated fracture with an enormous length has touched at depth the ultramafic zone of magma and has facilitated its upwelling to the surface. The study of tectonic map of Afghanistan and the field relations along this fault led the author to believe that the Chaman fault is not a suture (Fig. 2). The reason for the same will be discussed in the following paragraphs.

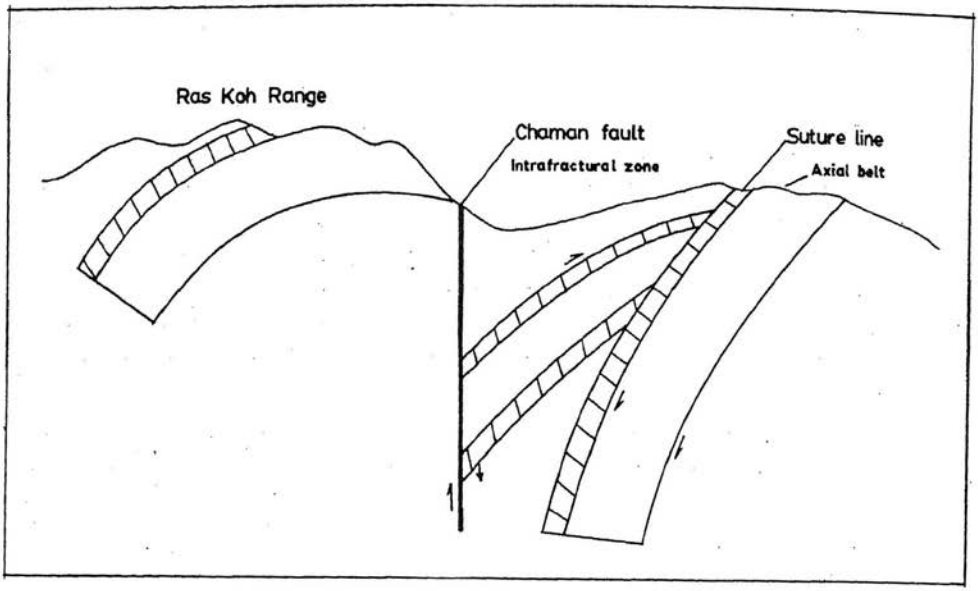

Fig. 2. Diagramatic section across the Las Bela-Zhob suture trace and the Chaman fault.

IV. Makran–Chaman–Lora Rud–Gardez–Chitral–Yasin Belt.

The isolated outcrops of acid, basic and ultramafic rocks occur along a big fracture which appears to start from Makran and runs upto Karakoram passing through Baluchistan, Afghanistan and northern areas of Pakistan. In the north of Gardez east-southeast of Kabul in Afghanistan, this fracture on the surface seems to be disturbed and displaced laterally by a north-south trending fault. But the ultramafic intrusions along this fault in the north of Drosh in Chitral trend parallel to the 'greenstone' complex in Chitral. Further north the fracture extends to Yasin and turns to the east into the Karakoram range. The ultramafic bodies north of Skardu seem to belong to this belt. Between this belt and No. I lies a narrow wedgelike depression filled by middle and upper Tertiary sediments, and is named by the author as intersutural zone (Fig. 2). Moreover, the ophiolites in other belts are associated with Cretaceous sediments, while the igneous rocks along the Chaman fault have different ages.

CONCLUSION

The occurrence of these ophiolite belts with irregular, isolated, variously shaped, small and large pods of ultramafics and other constituents, and their field characteristics are indicative of sutures between two plates or sub-plates. However, the linear Chaman belt, where the igneous rocks of different ages with composition from acid to ultrabasic outcrop, seem to be a deep seated fracture of its own independent occurrence. It behaves like an oblique slip fault with a left-lateral slip and an upthrow on the western side. However, a study of this fault and adjacent areas may determine its exact nature.

The ophiolite belts occur between independent blocks but the position of the wedgelike narrow depression between I and IV which runs from Khuzdar to Haramosh and southwards down to Titwal is anomalous and needs an explanation.

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