Elements of the Neo-Tethys ocean crust, island ascs and the Ladakh bathlith of the Aisan margin

3. Elements of the Neo-Tethys ocean crust, islands ascs and the Ladakh bathlith of the Asian margin

Oceanic crust, Spongtang klippe, Karzok unit and blueschists of the Indus suture zone.

Obducted oceanic lithosphere on top of the North Himalayan nappes crops out in the Kiogar ophiolite nappe in the Kumaon (Heim & Gansser 1939, Gansser 1964) and the Spongtang klippe in Zanskar (Reuber et al. 1987). In the NW Indian Himalaya, ophiolitic melanges with serpentinites and peridotites, gabbros, pillow basalts of a MORB composition and Late Jurassic radiolarian cherts and limestones occur in the two major ophiolitic melange zones north and south of the Dras-Nindam unit. Blueschists occur in tectonic melanges with Late Cretaceous foraminiferal limestones (Honegger et al. 1982, 1989). In the Spongtang klippe, Reuber et al. (1987) distinguish an upper thrust sheet consisting of tectonized harzburgites and a lower one composed of an ophiolitic melange, Dras volcanics and flysch with Maastrichtian to Paleocene fossils (Garzanti et al. 1987). The Nidar ophiolites (Fuchs & Linner 1996, Mahéo et al. 2000), comprising pillow lavas, gabbros and slightly serpentinized lherzolitic peridotites, are exposed in the Indus suture zone, north of Ribil. The Karzok ophiolite, consisting of a chromite and metagabbro lens, situated on the thrust plane between the Tetraogal and Mata nappes, crops out on the W shore of the Tso Morari (Steck et al. 1998). The mafic rocks of the Spongtang klippe, the Nidar and Karzok ophiolites are considered to be cogenetic. REE patterns and radiogenic Nd isotopic compositions are diagnostic of an N-Morb like depleted mantle source (Mahéo et al. 2000). The authors consider the Spongtang, Nidar and Karzog ophiolites as slices of a same immature intra-oceanic arc. Blueschists occur along the Indus suture in Ladakh in the form of tectonic thrust slices and as isolated blocks within mélange units and in tectonic mélanges associated with Upper Cretaceous foraminiferal limestone (Honegger et al. 1982, 1989). Near Shergol in the Wakha valley, they lie in a mélange zone between the Dras-Nindam zone in the north and the Lamayuru zone in the south. The mineral assemblage of the metabasic volcanoclastic rock sequence is characterised by lawsonite-glaucophane/crossite-Na-pyroxene-chlorite-phengite-titanite±albite±stilpnomelane. P-T estimates indicate temperatures of 350 to 420°C and pressures around 9-11 kbar. Geochemistry indicates a primary alkaline character of the blueschists, which suggests an oceanic island or a transition MORB type primary geotectonic setting. K/Ar isotopic investigations yield middle Cretaceous ages (Honegger et al. 1989).

The Dras-Nindam Formation (Bassoulet et al. 1978a & b, 1983, Honegger et al. 1982, Dietrich et al. 1983)
(Callovian-Cenomanian)

The Dras volcanics and their lateral equivalent the shallow-water volcano-sedimentary Dras-Nindam flysch unit constitute a major geological zone, which follows the Indus Suture for more than 400 km between the Karakorum and Leh (Frank et al. 1977a, Bassoulet et al. 1978 a et b, 1983, 1984, Honegger et al. 1982, Dietrich et al. 1983). A 15 km-thick pile of thrust sheets, comprising volcanics, pyroclastics, volcanoclastic sediments and radiolarian cherts, are exposed near Dras. Island arc tholeiitic basalts alternate with dacitic rocks of the calc-alkaline series. Bulk-chemistry, REE-patterns and relictic primary minerals, such as magnesiochromite, clinopyroxene, hastingsite hornblende and Ti-magnetite, suggest that the volcanics belong to island arc tholeiite and calc-alkaline rock series, typical of present island arcs in the Caribbean and Pacific (Honegger et al. 1982, Dietrich et al. 1983). The associated flysch sediments yield Callovian to Cenomanian ages (that include inclusions of Albian to Cenomanian Orbitolina limestones, Wadia, 1937). According to Cannat & Mascle (1990), the volcano-detrital Nindam flysch deposits have an Aptian to Early Eocene age and represent the product of the erosion of a volcanic arc.

The Ladakh intrusives of the active Asian margin

Subsequent to the formation of the Upper Jurassic and Lower Cretaceous Dras volcanic arc of the NW Himalaya, the further subduction of oceanic crust produced large volumes of magmatic rocks of the Ladakh batholith calc-alkaline plutons, which intruded the Dras volcanics to the west of Kargil and the southern border of Asia from the Cenomanian to the Lutetian (Honegger et al. 1982, Cannat & Mascle 1990). To the north of the Indus-Tsangpo suture zone, the Eurasian plate was bordered over a distance of 2500 km by the 30 to 50 km-wide Andean type Transhimalayan (Gangdese) plutonic belt. The Ladakh intrusives represent a north-western segment of this belt. In the Ladakh range, the magmatic activity occurred between 103 and 50 Ma, i.e. between a Cenomanian gabbronorite of 103 ± 3 Ma (concordant U-Pb zircon age) and an Eocene quartz-diorite of 49.8 ± 0.8 Ma (U-Pb zircon age, Weinberg & Dunlap 2000). These ages are similar to the 94.2 ± 1 Ma to 41.1 ± 0.4 Ma U-Pb ages on zircon from samples of the Lhasa-Xigaze region in Tibet (Schärer et al. 1984). A 103 Ma Ladakh biotite-granodiorite intruded the Dras volcanics near Kargil, producing an aureole of contact metamorphism (Frank et al. 1977a). This cordillera type calc-alkaline suite testify to the partial melting of the Asian mantle above the NW-directed underthrust Neo-Tethys ocean floor. The Ladakh intrusives are generally non-metamorphic. Prehnite mineral assemblages in a shear zone within a diorite near of the village of Chumatang to the west of Mahe in the Indus Valley are interpreted as a product of a post-magmatic hydrothermal activity, rather than of a regional metamorphic overprint (Schlup et al. 2003).

4. The Himalayan tectonics, metamorphism, magmatism and sedimentation

The Indus Group (Garzanti & Van Haver 1988)
(synonyms: Indus Molasse, Tewari 1964, Fuchs 1982; Indus Clastics, Garzanti & Van Haver 1988)
(Late Cretaceous-Neogene)

Late Cretaceous to Neogene sediments were successively deposited in a fore arc basin of the Ladakh batholith and in an