OCEAN ARC-CONTINENTAL MARGIN COLLISION IN THE SHYOK SUTURE ZONE , N PAKISTAN

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Introduction

The Shyok Suture Zone (Northern Suture) in Northern Pakistan separates the Karakoram Terrane to the north (Eurasia) from the Kohistan Terrane to the south (Cretaceous island arc). The Shyok Suture Zone was in the past interpreted as a narrow back-arc marginal basin that opened in the Early Cretaceous between the Kohistan arc and the Eurasian (Karakoram) margin (Pudsey 1986). Alternatively, the Kohistan arc was formed at near-equatorial palaeolatitudes (above either a N- or S-dipping subduction zone; Khan *et al.* 1998) and later drifted northwards as part of a Neotethyan oceanic plate that was subducted northward beneath the Eurasian margin. In either model the Shyok Suture Zone was sutured in pre-Tertiary time (pre-75 Ma). Currently, the Shyok Suture Zone is summarised as "melange including sedimentary and tectonic melanges with blocks of volcanic rocks, limestone, quartzite and serpentinite in a shaley matrix" (Geological Map of North Pakistan), although few detailed studies have been published (except for Pudsey in the east).

We are currently investigating the Shyok Suture Zone in N W Pakistan (Baltistan), centred on Skardu (especially NW of Skardu; Searle and Khan 1991). Based on regional mapping of the Chogo Lungma/Tarmac area (Le Fort *et al.* 1995) the suture zone was recently interpreted as a low-grade (greenschist) metamorphic tectonic melange, divided into a "Southern Band", a thick-volcanic-sedimentary unit, and a "Northern Band", comprising "tectonic lenses" including ophiolitic lithologies.

Main results of field work

We first mapped a corridor across the Shyok Suture Zone from the Askole Amphibolite (Gilgit complex) in the SW (near Dasu) to the Main Karakoram Thrust exposed in tributaries NE of Shigar, combined with detailed logging (Figs. 1, 2). We recognise the following litho-tectonic units from the structural base upwards:.

i) ***Basal ultramafic unit*** (ophiolitic; ca. 1 km), overlain by talc-rich sediments (Dasu);

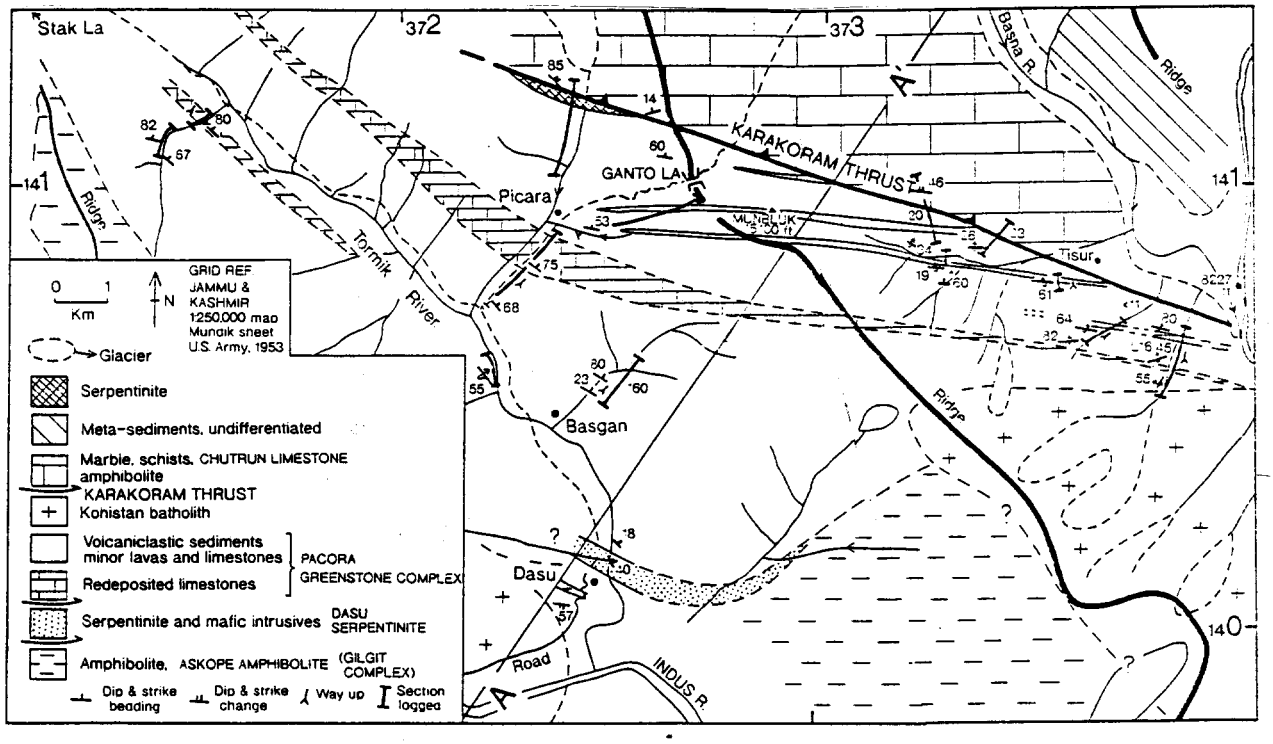

Fig. 1 Map of area studied NW of Skardu

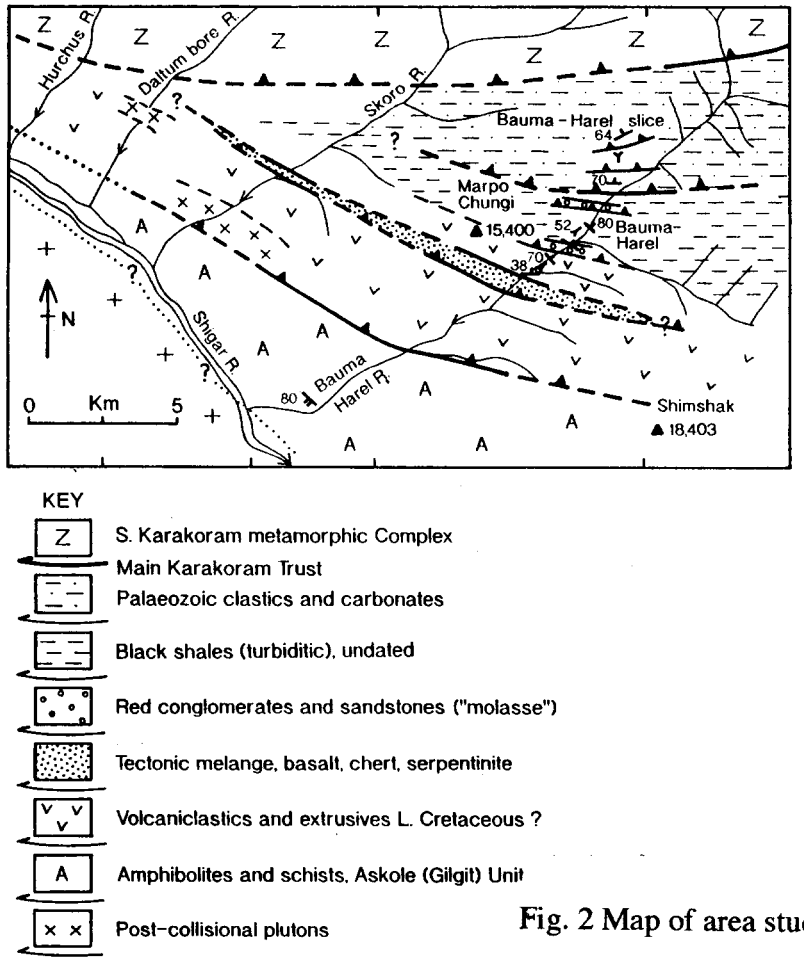

Fig. 2 Map of area studied N of Skardu

ii) *Lower volcanogenic unit:* (ca. 4 km) an intact succession of green volcaniclastic turbidites and volcanogenic debris flows, micaceous shales, fissile tuffs, basic-intermediate-acidic lava flows/breccias and local limestone lenses (upper Turmik valley/lower Skoro valley/Bauma-harel area).

iii) *Carbonate-volcanogenic unit:* (ca. 2 km) dominated by the "Pacora Limestone", redeposited carbonate (calciturbidites) interbedded with subordinate carbonate debris flows and micaceous sediments as lenses up to 800 m thick, intercalated with volcanogenic sediments and minor lava flows (Ganto-La/Munbluk/Tisar areas),

iv) *Upper volcanogenic unit* (ca .4 km) *:* Heterogeneous volcanogenic sediments (structurally thickened), dark phyllite, pale tuff, silicic and intermediate lava/lava breccias and calciturbidites (Ganto La/Tisar; Skoro R./Bauma-harel areas);

v) *Serpentine-basalt-chert complex.:* (<250m), imbricated tholeiitic basalt (pillow lava/breccia-analysis in progress), red radiolarian chert and serpentinised ultramafic rock intercalated with greenish volcaniclastic sediments (Bauma-harel area/Skoro R.).

vi) *Conglomerate-sandstone-shale* (ca. 0.5 km- several slices). Reddish sediments (fluvial?) including well-rounded clasts of mainly volcanogenic lithologies forming thrusts sheets, locally between vi) and within viii) (Bauma-harel area);

vii) *Terrigenous shale-sandstone unit*: (>2 km). dark micaceous shales, subordinate quartzose sandstones and siltstones (turbiditic?) (Bauma-harel R/Skoro R etc.)

vii) *Shale-sandstone-limestone-conglomerate unit*: (>2km). Early Carboniferous (and older)/Early Mesozoic? shallow to deeper marine succession (Bauma-harel area).

viii) *Serpentinite shear zone*, marking the Main Karakoram Thrust, cuts obliquely across units iv)-viii) and overlain by high-grade metamorphic rocks (Eurasian).

Units are interpreted as: i) oceanic arc basement; ii-iv) a coherent (in the SW) to thrust imbricated (in the NW) Lower Cretaceous arc-margin succession (northward younging; apparent thickness ca. 10 km). Limestones are channelised calciturbidites and not tectonic blocks or slices; v) imbricated oceanic arc basement; v-vi) Late Palaeozoic-Early Mesozoic? mixed carbonate/siliciclastic shelf sediments overlain by terrigenous unstable slope succession with minor volcanics (Eurasian margin).

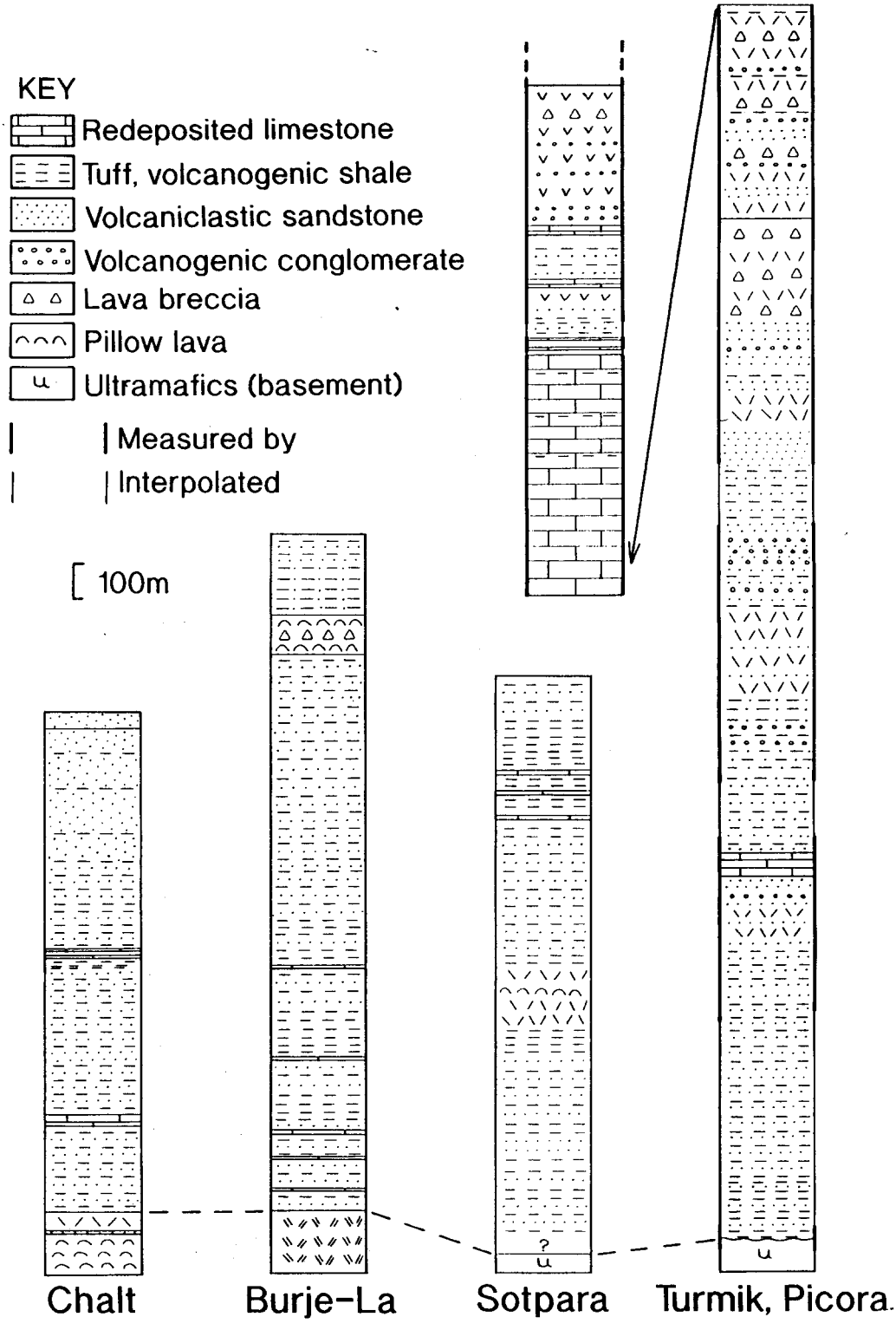

Fig. 3 Summary logs of areas studied

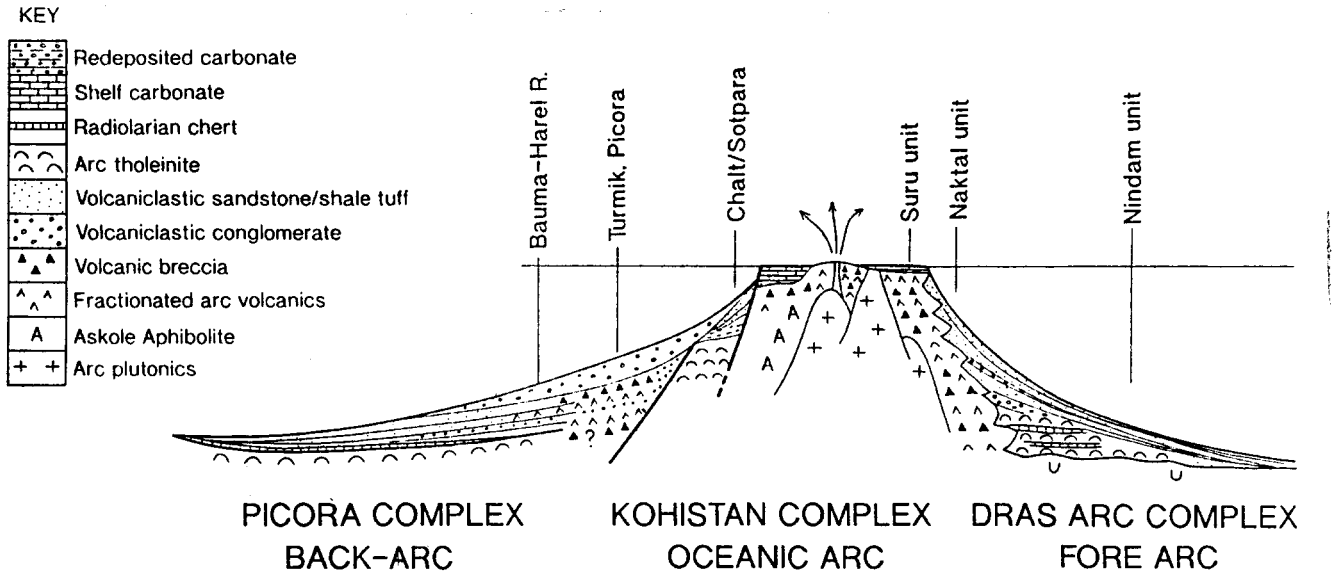

Fig. 4 Reconstruction of Kohistan arc

Secondly, we investigated Cretaceous volcanic/sedimentary units in a structurally separate area further S (S of Skardu), previously mapped as Kohistan arc (Yasin Gp.). Compared to the Shyok Suture Zone further N (see above):

i) General facies similarities suggest correlation as relatively proximal units of mainly unit iv) above; ii) Large-scale thrust imbrication exists, with included thin slices of serpentinised ultramafic rocks and fluvial? "molasse".

Thirdly, we investigated lithologies further E (Thalle and Hushe valleys), areas previously mapped as Karakoram Batholith. Well exposed volcanogenic successions there (intersliced with local "molasse") can be generally correlated with unit iv) (Shigar area). Abundant siliceous tuffs are interbedded with relatively thin-bedded lithoclastic/silicic turbidites?, without limestone.

Interpretation and conclusions

Overall, the areas studied divide into: i) coherent, or thrust imbricated Cretaceous Kohistan arc-margin volcanogenic sediments, volcanics and redeposited limestone, associated with oceanic basement (serpentinite/lava slices)(see Figs. 3, 4); ii) Palaeozoic/Early Mesozoic? shallow to deeper-marine continental margin successions of Eurasian (Karakoram) affinities. Accreted units e.g. large-scale "olistostromes", or exotic tectonic melange are entirely absent. No evidence of any other unit from between the Kohistan oceanic arc and the Eurasian (Karakoram) is preserved. Petrographic studies do not indicate the presence of any terrigenous (Eurasian-margin) derived sediment within the inferred Kohistan arc-margin units. The regional evidence favours collision of the Dras/Kohistan arc along the Shyok Suture Zone by latest Cretaceous time (pre-75 Ma). Any intervening Neotethyan oceanic crust was subducted without trace. The arc was exposed and underwent shallow fluvial erosion prior to large-scale thrust imbrication, possibly related to Late Cretaceous arc/Eurasian margin collision. Tertiary overthrusting along the Main Karakoram Thrust conceals much of the suture zone especially in the east.

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