IS THE KAPUSKASING STRUCTURE THE SITE OF A CRYPTIC SUTURE?

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In 1968 J. T. Wilson suggested that the Circum-Ungava suture zone continued through the Kapuskasing to join the Penokean fold belt (Fig. 1) implying that the Kapuskasing marked the site of what has since come to be known as a "cryptic suture" (e.g., Burke and Dewey, 1973). Later workers, however, including both those who followed Wilson in relating the Circum-ungava structure to ocean opening and closing (e.g., Gibb and Walcott, 1971; Burke and Dewey, 1973) and those who recognized only rift features within it (e.g., Baragar and Scoates, 1981) have preferred to extend the Circum-Ungava structure through the Thompson (Nelson) zone of Manitoba (Fig. 1).

Now Percival and Card (1983, see especially Fig. 2) have demonstrated that the Kapuskasing structure involves substantial thrusting of deep continental crustal rocks over shallower continental rocks. Because this is a process typically (though not uniquely) associated with continental collision, there may be a case for looking again at Wilson's original suggestion.

Problems arise in attempting to reconcile Wilson's idea with data from more recent studies:

1) Could the Kapuskasing and the Thompson belt both mark sutures of about 1700 Ma age?

Geometric relations similar to those shown in Fig. 1A with the subsurface extension of the Thompson belt meeting the Circum-Ungava and Kapuskasing structures in a T-junction are known from numerous places around the world where collisional mountain belts join (e.g., in the Damarides of Namibia) these junctions have been called "Aral knots" (Sawkins and Burke, 1980, Fig. 1) from the type example where the Urals meet the Hercynian fold-belts of Europe and Kazakhstan.

2) Why is there no age difference across the Kapuskasing if it does mark the site of a continental collision?

For the Kapuskasing to mark a collision without age resetting (except for that contemporary with information of the Ivanhoe Lake cataclastic zone, Percival and Card, 1982) would require that the western Superior province 'docked' gently against the east without producing any of the effects usually recognized at collision.

3) Why is there no offset of the Superior subprovinces across the Kapuskasing?

Percival and Card (1983, p. 326) report that there is no major offset of the Abitibi - Opatica boundary across the Kapuskasing. It would be remarkable for the belts to have been sutured together in a matching configuration.

If Wilson's (1968) interpretation of the Kapuskasing structure is valid, the suturing involved would have had to be remarkably cryptic, but because we know very little of the properties of suture zones (except for their complexity, Dewey, 1976) and because Wilson has proved right so often in the past, it would seem that his hypothesis merits further testing.

Percival and Card's perception (1983) that the timing of tectonic events in the Kapuskasing matches that of events elsewhere in the Canadian shield opens the way for other possible explanations of the origin of the Kapuskasing structure. The age of the Ivanhoe Lake cataclastic zone in the Kapuskasing (reported as 1720 Ma, Percival and Card, 1983) is similar to that of an event which has been interpreted as collisional on the Thompson front and this leads to the suggestion that the Kapuskasing may be an isolated upthrust area within one of two colliding continents, possibly comparable to the present-day Tien Shan (Fig. 2B), a 5 km high upthrust range produced in the active Indian-Asian continental collision (Molnar and Tapponnier, 1975).

The Tien Shan uplift is: 1) contemporary with collision and suturing 1000 km away; and 2) isolated within an area that has not been uplifted; and 3) apparently not associated with igneous activity (i.e., it is unlikely to have reactivation and resetting of isotopic systems at depth).

A significant difference between the active Tien Shan and the ancient Kapuskasing structure is that the former occurs on the side of the Indus suture zone which carried an Andean arc before continental collision (the "hot" side) while the Kapuskasing occurs on the opposite side (the "cold" side). If this proves to be a significant difference, then the isolated uplifted areas of Peninsular India (e.g., the Nilgiri Hills, about 2 km high), may prove a better analogue of the Kapuskasing structure. A representation of how the Indian-Asian and Superior-Churchill collisions might be analogous is sketched in figure (2).

References

Baragar, W.R.A. and R.F.J. Scoates (1981). The Circum-Superior belt: a Proterozoic plate margin? In pp. 297-330 in Precambrian Plate Tectonics ed. A. Kroner, Elsevier, Amsterdam.

Burke, K. and J.F. Dewey (1973). An outline of Precambrian plate development in D.H. Tarling and S.K. Runcorn (editors) Implications of Continental Drift to the Earth Sciences, Academic Press, London, vol. 2, p. 1035-45.

Dewey, J.F. (1976). Suture zone complexities; a review: Tectonophysics, v. 40, p. 53-67.

Gibb, R.A. and R.I. Walcott, (1971). A Precambrian suture in the Canadian shield Earth and Planetary Sciences, v. 10, p. 417-422.

Molnar, P. and P. Tapponier (1975). Cenozoic Tectonics of Asia: effects of a continental collision, Science, v. 189, p. 419-421.

Percival, J.A. and K.D. Card (1983). Archean crust as revealed in the Kapuskasing uplift, Superior Province, Canada. Geology, v. 11, p. 323-326.

Sawkins, F.J. and K. Burke (1980). Extensional tectonics and mid-Paleozoic massive sulfide occurrences in Europe: Geol. Rundsch, v. 69, p. 349-360.

Wilson, J.T. (1968). Comparison of the Hudson Bay Arc with some other features, pp. 1015 and 1033. In Science, History and Hudson Bay, ed. C.S. Beals. Publ. Dept. Energy Mines and Resources, Ottawa.

THE KAPUSKASING STRUCTURE

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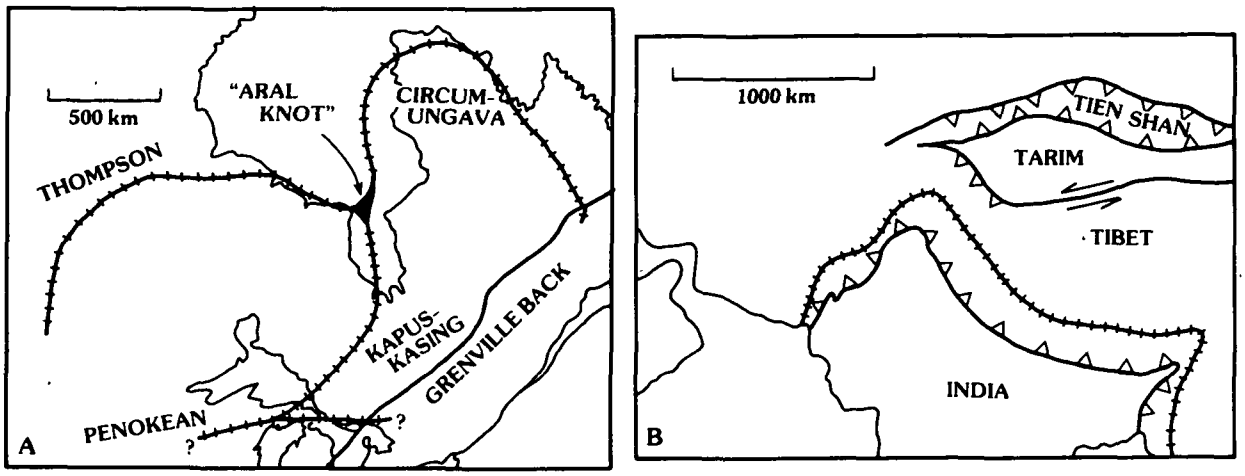


Fig. 1 (A). Possible distribution of suture zones in the Canadian shield. Wilson's (1968) suggestion that the Kapuskasing marks a cryptic extension of the Circum-Ungava suture and Gibb and Walcott's (1971) suggestion that the extension is in the Thompson belt are both assumed valid. The kind of suture T-junction illustrated is common and is known (from the type example) as an Aral knot.

(B) Sketch illustrating the disposition of the Tien Shan (an isolated 5 km high upthrust mountain range in Asia) with respect to the Himalaya and the Indus-Yarling Dzangpo suture zone. A continental collision on the Thompson front 1700 Ma ago might have generated the Kapuskasing upthrust zone as a structure similar to the Tien Shan of today. This explanation seems more compatible with the evidence than the idea that the Kapuskasing marks a cryptic suture-zone.

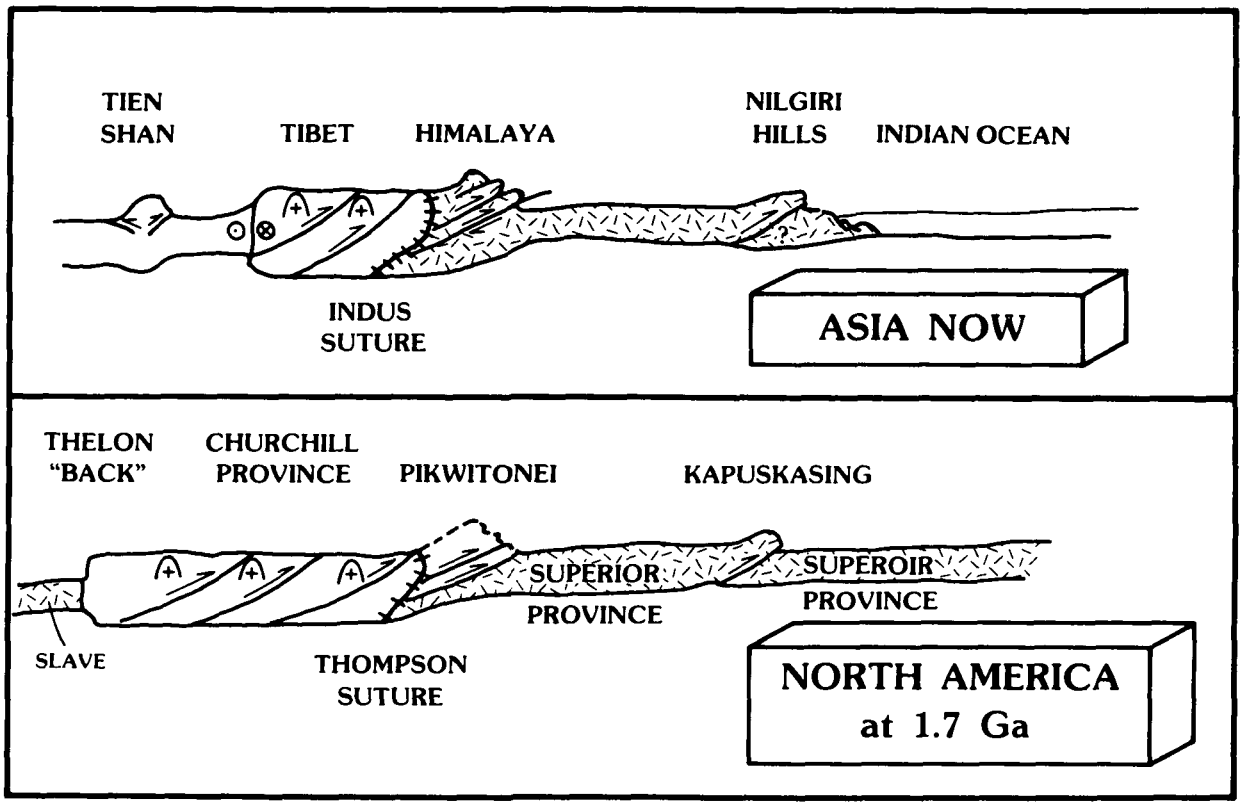


Fig. 2. A comparison of the structure of Asia now (illustrated in the upper sketched cross-section) and North America 1.7 Ga ago (lower sketched cross-section) to illustrate that just as uplift of an isolated area in Peninsular India (e.g., the Nilgiri Hills) may be related to the Himalayan collision so uplift forming the Kapuskasing structure may have been related to a comparable collision along the Thompson front. On this interpretation Peninsular India and the Superior Province play similar roles at collision; the Pikwitanei subprovince marks the site of an eroded analogue of the Himalayan range. The Indus and Thompson suture zones are comparable, the Churchill province is an analogue of Tibet with thickened continental crust and reactivation. The Thelan 'back' marks the boundary between thickened and unthickened continental crust and is analogous to the northern boundary of the Tibetan plateau. The Tien Shan, an alternative analogue of the Kapuskasing structure, is shown on the Asian cross-section.