

LATE ARCHEAN GREENSTONE TECTONICS -- EVIDENCE FOR THERMAL AND THRUST-LOADING LITHOSPHERIC SUBSIDENCE FROM STRATIGRAPHIC SECTIONS IN THE SLAVE PROVINCE, CANADA; W.S.F. Kidd, Dept. Geol. Sci., SUNYA, Albany, NY 12222, USA, T.M. Kusky, Dept. Earth Sci., Johns Hopkins Univ., Baltimore, MD 21218, USA, D.C. Bradley, LDGO, Palisades, NY 10964, USA

Subsidence in rifts and passive continental margins is driven by stretching and subsequent cooling and thickening of the lithosphere(1); subsidence in foreland trough basins is a result of thrust-loading and flexure of the lithosphere(2). Sediment sequences localized by these different mechanisms have distinctive sequences of facies and are one of the more convincing forms of evidence for the operation of plate tectonics in the Palaeozoic and Proterozoic. Archean examples of such sequences have not been so obvious, perhaps because none are preserved in little deformed state, and the most likely candidates on the basis of lithological assemblages for passive margin sequences (3,4) are not only highly deformed and structurally dismembered but are also strongly metamorphosed. We have identified intact stratigraphic sections of passive margin type, and others of foreland trough-type in deformed but low-grade Archean rocks in several extremely well-exposed areas of the Slave Province, N.W.T., Canada. These sequences are similar in most respects to younger examples and support the hypothesis (5,6,7) that tectonic processes similar to those operating now were active in the Archean.

On both the north and south arms of Point Lake an intact stratigraphic sequence above a thick conglomerate containing shallow-water arenites and intercalated mafic and felsic volcanoclastics and volcanics starts with a unit of black pyritiferous slate and argillite of 60-200 m present thickness. This contains a minor proportion of siderite iron formation, calcarenite-siltite and limestone breccia beds and, adjacent to the volcanics at the base, local quartzose and tuffaceous silts and arenites. These black slates are conformably succeeded by a thick sequence of quartzofeldspathic turbidite greywackes and pelites, with local magnetite iron formation in some of the pelitic intervals. The turbidites coarsen and thicken upward through the basal 20-100 m. The overall sequence of turbidites is several km thick and is imbricated by thrusts directed westwards. We interpret this sequence to be the product of submarine thrust-loading subsidence, with the black slates being the outer trench slope deposits and the turbidites the trench floor deposits, subsequently incorporated into an accretionary thrust stack.

Sections in the Cameron River belt, in the area of Upper Ross Lake-Victory Lake-Detour Lake, lie with observed unconformity on tonalitic gneisses. At Detour Lake, deformed but low grade sediments consisting largely of quartz and carbonate arenites, with a basal biotite phyllite matrix conglomerate and a local upper unit of calcsilicates and marbles, form a section about 500 m thick. Similar sediments are much thinner nearby, along strike, but 500 m of quartzites in the same tectonic position are reported (8) in the Beaulieu River region farther north. These shallow water sediments, which we interpret as a passive margin sequence, are truncated by a major thrust carrying greenstone belt lithologies generally southwestward, except near Detour Lake, where the section passes up through a 100 m thick interval of pelite and iron formation to a quartzofeldspathic turbidite sequence, of overall great thickness, and probably cut by many thrusts. This change to turbidite deposition we also interpret as the development of a submarine foreland-basin caused by thrust-loading.

Sequences like these are not unique to the Slave Province but the recognition of their significance depends on good outcrop and being able to identify which contacts are stratigraphic and which are important faults. Similar passive margin-type sequences are well documented from Zimbabwe (9) and the Superior Province (10); in both cases the sediments lie unconformably on older basement and are only a maximum of a hundred to a few hundred meters thick. We interpret adjacent volcanics, including komatiites in Zimbabwe, to be in tectonic contact with the sediments, as they are observed to be in the Slave Province. Within the Archean, the Witwatersrand basin has been suggested to be a foreland basin due to thrust-loading subsidence (11); within Archean greenstone belts, the only documented thrust-loading subsidence sequence is that of the Barberton Mtn Land (12); they are probably common, and several potential examples, which we have not yet had the opportunity to examine, occur elsewhere in the Slave Province (data in 13). The change between the Bababudan and Chitradurga Groups (14) of southern India, and much of the sedimentation in the Chitradurga Group, is possibly of the same origin.

The thrust-subsidence sequences in the Slave Province are very similar in facies and thickness to Phanerozoic examples, particularly those from places where island arc terranes dominate, for example central Newfoundland (15). The combined effect of lithospheric thickness and the size of the load provided by the thrust stack must therefore have resembled the same combination of these two factors in more recent times. In contrast, the passive margin sequences, while of very similar lithologies in similar order to those in younger examples, are consistently thin in comparison with them, even allowing for thickness reduction by ductile strain. This difference can be interpreted in at least two different ways; one is that a higher mantle heat production caused slower lithospheric thickening and a smaller total equilibrium thickness after a rifting event, resulting in less overall thermal subsidence of rifted margins. Another is that rifted margins were more swiftly incorporated into convergent tectonic systems than in later times. Unless independent evidence on lithospheric thickness can be obtained from other aspects of the Archean record or these sequences can be much more precisely dated than at present, it may prove difficult to distinguish between these possibilities. This evidence does show, however, that tectonic processes active in the Archean had primary effects on the lithosphere indistinguishable from those of present plate tectonics.

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