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ABSTRACTS

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ABSTRACTS

THE ACCRETIONARY PRISM AND MAGMATISM OF THE GULF OF ALASKA

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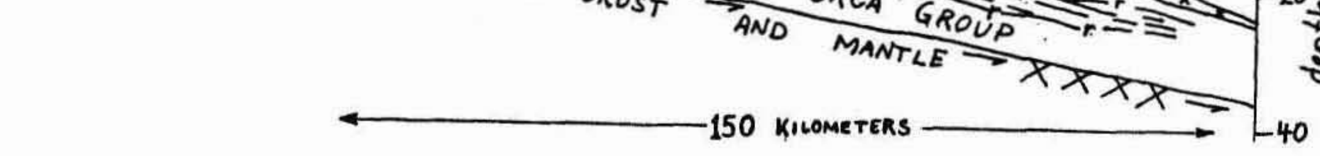
Accretionary prisms are important in generation of continental crust: (1) they are emplaced from surface to Moho, so any mantle-derived magma intrudes them; and (2) they are fertile in granitic melt--especially those prisms rich in graywacke--and all their sediments are easily assimilated by gabbroic liquid. Prisms are found in the Archean (for example, Quetico Belt) and are abundant in the Proterozoic and younger eras.

The Gulf of Alaska contains a large (100-200 X 2,100 km), composite prism of Cretaceous to Eocene rocks emplaced about 65-50 Ma. This prism was formed by (1) accretion of the Wrangellia-Alexander composite terrane to southeastern Alaska and British Columbia about 110-100 Ma, with crustal overthickening; (2) growth of an Andean arc in this collage; (3) uplift of this arc of 20-30 km and outflow of turbidites onto the north-moving Kula plate(s); (4) magmatism of arc and MORB-seamount-transform types into the Kula-with-turbidite crust; and (5) offscraping against the continental margin with continued basaltic magmatism. The Cretaceous part of the prism consists of graywacke, pelite, basalt, and an island-arc fragment. The Paleocene to Eocene part--the Orca Group--consists of quartzofeldspathic graywacke, 15-20% basalt, and minor pelagic sediment.

Granitic rocks formed at 63-53 Ma in the western Gulf of Alaska, and at 53-50 Ma in the eastern Gulf. The Orca Group rocks, near Cordova, eastern Gulf, contain scattered plutons of granodiorite of 5-150 km^2 area. Rare coeval gabbro plutons and trondhjemite dikes also occur. Three granodiorite plutons studied here show SiO_2=66.3-71.3%, Na_2O=2.8-3.6%, K_2O=1.8-3.0%, ε_{Nd}=+2.1 to -3.3, $^{87}Sr/^{86}Sr$=0.7051-0.7067, $^{206}Pb/^{204}Pb$=19.04-19.20, $^{207}Pb/^{204}Pb$=15.60-15.66, and $^{208}Pb/^{204}Pb$=38.59-38.85. One pluton generally shows slightly lower K_2O, higher Al_2O_3, higher ε_{Nd}, and lower $^{87}Sr/^{86}Sr$ ratios. All three plutons, however, have similar, well-defined minor and trace-element abundances characterized by relative enrichment in light rare earth elements and depletion in high field strength elements.



Schematic present-day section through accretionary prism at Cordova. Overall control by seismic methods, but note that clear signals were received only from that part of the Orca Group where reflectors (=r) are shown. Present-day surface about 4-7 km below that at 50 Ma.

The granodiorite plutons and flysch of the Orca Group show overlapping elemental and isotopic compositions. The only clearly defined chemical differences between the flysch and the plutons are weak negative Eu anomalies in the plutons and slightly lower Ca and higher Na contents in the flysch. The Nd and Sr isotopic compositions of two plutons completely overlap those of the flysch. The third pluton, however, shows discretely higher ε_{Nd} and slightly lower $^{87}Sr/^{86}Sr$ values than those of the flysch. Pb isotopic compositions of the flysch and this pluton also overlap, but Pb of the other two plutons is slightly less radiogenic.

Our chemical data, modeling, and comparison with melting experiments (Conrad and others 1988) of graywacke indicate that the granodiorite originated by large fractions (65-90%) of melting of the Orca Group graywacke and argillite. Plagioclase, pyroxene(s), and biotite(?) were residual to melting at about 850°-950°C and at low H_2O activities. The trondhjemitic dikes have elemental and isotopic compositions (for example, ε_{Nd}=+7.9, Sr_i=0.7036) appropriate to origin from a basaltic protolith.

These granodiorite plutons were generated where the prism was 15-20 km thick and while the prism was still being deformed. They are wholly flysch derived, do not contain a gabbroic component, yet were coeval with gabbro and trondhjemite. This magmatism is best explained by (1) introduction of basaltic liquid from the Kula plate during subduction; (2) pooling of basaltic liquid in lower regions of the prism; (3) growth of melting-precipitating cells in flysch over convecting, crystallizing lenses of gabbroic magma (as in Huppert and Sparks, 1988); and (4) requiring lenses of layered gabbro 1-3 km thick and thinner layers of flysch-melt residua.