Constraints on the original setting of the flysch of the Chugach and Prince William terranes in Alaska using detrital zircon

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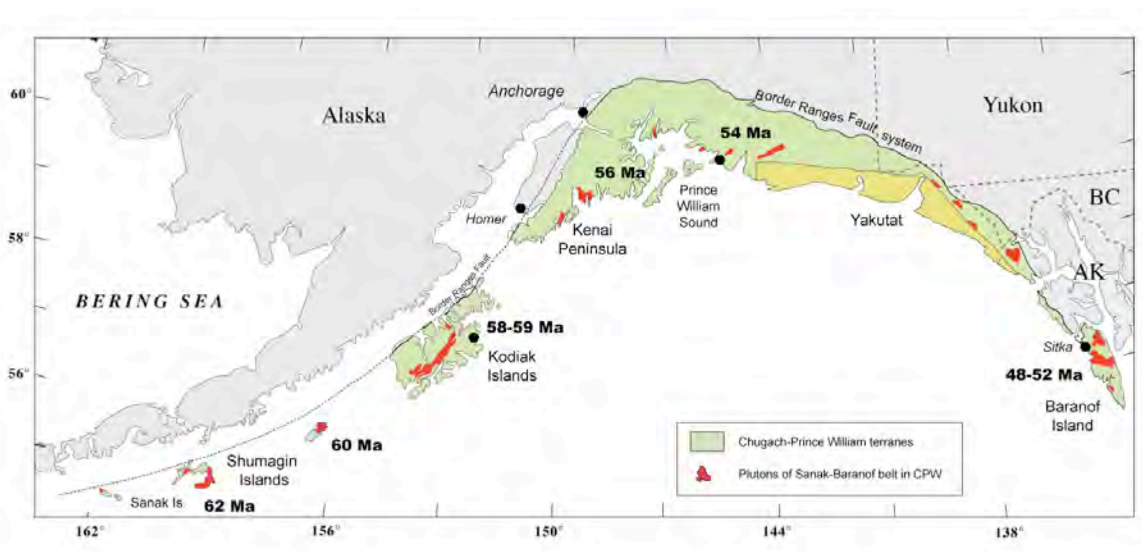
Flysch of the Chugach-Prince William (CPW) terrane in southern Alaska represents an enormously thick Maastrichtian to Eocene accretionary complex that formed adjacent to an active volcanic arc. Several thousand detrital zircon grains from sandstone samples across the belt indicate the source of sediment was an active Cretaceous to early Tertiary arc built primarily on a metaplutonic basement that was Upper Paleozoic to Lower Cretaceous in age. The Campanian-Maastrichtian to Eocene flysch is remarkably uniform in composition and grain-age distribution along the margin from Baranof Island in the east to the Shumagin Islands in the west. Temporal variation in sandstone composition and grain-age distribution from the Maastrichtian to the Eocene is minor, but there is an increase in the fraction of grains attributed to the active (or near active) volcanic arc. We have focused on U/Pb and fission track (ZFT) dating zircon from the flysch in four areas along the continental margin, and at this point in our evaluation, a primary requirement of the source terrane is that it must be comprised of a relatively homogeneous assemblage of Mesozoic rocks that have been deeply and continuously exhumed from the Late Cretaceous to the Eocene.



The thickest and most continuous section of the accretionary complex is in the central part of the CPW belt from Turnagain Arm (near Anchorage) through western Prince William Sound (southeast of Anchorage). Here, the detrital zircon record in the flysch is remarkable in that it shows the progressive evolution of an exhuming volcanic arc (from c. 75 to 55 Ma, and younger) that was superimposed on a Jura-Cretaceous metaplutonic basement complex that changed little in character through progressive exhumation. Paleocene ophiolites in the Prince William terrane (Knight Island and Resurrection Peninsula) have pillow basalts that are interbedded with, and overlain by, clastic strata of the Orca Group, and our new data indicate that we can tie these ophiolitic rocks to continentally derived strata (Pettiette et al., this volume). Paleomagnetic data from the Paleocene Resurrection Peninsula Ophiolite (~57 Ma) indicate translation of ~13°± 9° (Bol et al., 1992) and data from the slightly older Ghost Rocks Formation on Kodiak Island (>61 Ma) indicate translation of ~23° ± 6° (Gallen, 2008; Housen et al., 2009). Both of these data sets need to be considered in tectonic reconstructions of the CPW.

The least exposed and perhaps thinnest part of the terrane occurs far to the west in the Sanak and Shumagin Islands, where CPW rocks are barely emergent in the modern forearc. On Nagai Island (in the Shumagins), our new data indicate that the Maastrichtian Shumagin Formation was derived from a similar source as correlative units on Kodiak and in Prince William Sound: an active volcanic arc (70-75 Ma) and underlying metaplutonic complex (150-175 Ma). Deposition was followed by folding and imbrication, burial in the subduction wedge, and intrusion by the Sanak-Baranof Belt of plutons (here at ~62 Ma), which are inferred to be evidence of near trench plutonism related to the slab window of an adjacent TRT triple junction. Zircon fission track (ZFT) cooling ages between 58 and 54 Ma provides information about the original maximum burial depth (Roe et al., this volume).

In all detrital samples analyzed across the entire 2000 km long belt by our group and others, there is a small but significant fraction of Precambrian grains that vary in abundance (generally ~1 to 10%) and age distribution. These Precambrian zircons provide an important clue about the nature of basement terranes that were likely supplying zircons in the source regions. The Precambrian grains fall into two distinct cohorts: (1) zircons from the Shumagin, Kodiak, and PWS areas have a wide range of Precambrian ages with modes at 1810-1870 Ma and 2520-2680 Ma, similar to a northern Laurentian source. Raman spectra show that these grains have considerable internal disorder due to accumulated radiation damage for hundreds of Myr and are likely from a Paleozoic-cooled source; (2) Precambrian zircons of the Yakutat Group have modes at c. 1380-1450 and 1710-1740 Ma, which are similar to the Yavapai-Mazatzal province of southern Laurentia. Despite being Precambrian, this latter group of zircons have little internal disorder and appear to have cooled (started accumulating radiation damage) in the late Mesozoic (c. 100 Ma).

Our data are compatible with previous interpretations that the CPW is the accretionary complex to the Coast Mountains batholith. Paleomagnetic data from the volcanic rocks on Kodiak Island and on Resurrection Peninsula indicate latitudinal displacement that could be as much as 13° to 23°, which would put deposition and accretion of much of the CPW in the central or southern North American Cordillera. Ages, radiation damage, and hafnium isotopes (Roberts et al., this volume) of detrital zircon also appear to limit possible source terranes for some of the CPW to terranes that are presently far to the south.

Bol, A.J., Coe, R.S., Grommé, C.S., and Hillhouse, J.W., 1992, Paleomagnetism of the Resurrection Peninsula, Alaska: Implications for the tectonics of southern Alaska and the Kula Farallon Ridge: Journal of Geophysical Research, v. 97, p. 17,213-17,232.

Gallen, S.F., 2008. An investigation into the magnetic fabrics and paleomagnetism of the Ghost Rocks Formation, Kodiak Islands, Alaska; MSc. Thesis, Western Washington University, 119 p.

Housen, B. A., S. M. Roeske, S. Gallen, and K. O'Connell (2008), Paleomagnetism of the Paleocene Ghost Rocks, Kodiak Islands, Alaska: Implications for Paleocene Pacific-Basin/North America Plate Configurations, Eos Trans. AGU, 89(53), Fall Meet. Suppl., Abstract GP44A-02.

Reviving Ray Price's conceptual model of continuous ductile extrusion/intrusion of "hot tongues" in orogenic belts

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In the early 70's, Raymond A. Price proposed a tectonic model for the Canadian Cordillera involving buoyant upwelling of the infrastructure driving thrusting in the foreland-belt. Although we now know that the driving force was mainly horizontal and linked to the movement of tectonic plates, several aspects of the model are being rediscovered as potentially fundamental processes in orogenic systems. According to Larson et al., 2010 (rephrased from Price (1972): *"The deep hinterland is characterized by extending flow and the lateral extrusion of hot ductile rock, while the shallow foreland is characterized by compressing flow and the intrusion of formerly hot cooling rock.".* Furthermore, referring to the hot ductile rocks as "hot tongues", Price and Mountjoy (1970, p. 18) stated that this would be a "… *continuing process, in which earlier tongues are eventually uplifted and domed above later tongues that moved in and spread out beneath them*."

In this contribution, we will present stratigraphic, structural, metamorphic and geochronological data from the Canadian Cordillera and the Himalayas supporting Price's conceptual model. This model differs from the channel flow model derived from numerical modeling in that the exhumation of hot ductile rocks is not controlled by intense erosion at the mountain front, but by a combination of their intrusion into colder and shallower rocks,