Age and provenance of the Upper Cretaceous to Paleocene Valdez Group of the Chugach Terrane from the Richardson Highway and Northern Prince William Sound, Alaska

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Abstract

Detrital zircon U-Pb ages from turbidites of the Upper Cretaceous Valdez Group of the Chugach terrane in Prince William Sound, Alaska help demonstrate the complex relationship with the outboard turbidites of the Paleocene-Eocene Orca Group. The Valdez and Orca Groups, while similar in composition, historically have been divided by metamorphic grade, age, and geography. Current mapping separates the older Valdez Group of the Chugach terrane from the younger Orca Group of the Prince William terrane along the Contact fault system. Turbidites of the Valdez Group are typically more deformed and record greenschist facies metamorphic conditions, while the younger Orca Group rocks record prehnite-pumpellyite conditions. Eight sandstone samples from the Valdez Group and nineteen from the Orca Group were collected from northern Prince William Sound and along the Richardson Highway. Detrital zircons were U-Pb dated at the Arizona Laserchron Center by LA-ICP-MS. Maximum depositional ages (MDA) of the Valdez Group range from 84 to 60 Ma and are concentrated in three clusters: 85-84 Ma, 70-68 Ma, and 62-60 Ma. The oldest cluster includes a previously published sample from Mount Magnificent near Anchorage and one from our study along the Copper River near Chitina that have similar Late Cretaceous populations between 84 and 97 Ma and in the Early Jurassic (186 and 196 Ma). Six samples with MDAs between 70-68 Ma have similar grain-age distributions with the majority of grains forming pronounced Late Cretaceous populations between 73 and 71 Ma. Three samples collected from rocks mapped as the Valdez Group along the Richardson Highway have MDAs between 62-60 Ma, and these have similar MDAs and grain-age distributions to rocks of the lower Orca Group in Prince William Sound. These samples are dominated by zircons with Late Cretaceous populations between 72-70 Ma and Early Cretaceous between 109-107 Ma. The young samples are Paleocene and are younger than what is traditionally viewed as the age range of the Valdez Group, and thus they present a dilemma. There are several options for their occurrence, including: 1) Orca Group rocks occur in the Valdez Group as structural slices or are depositional and subsequently folded into the Valdez Group; or 2) the youngest Valdez Group rocks are stratigraphically equivalent to those of the oldest Orca Group.

Geologic Setting

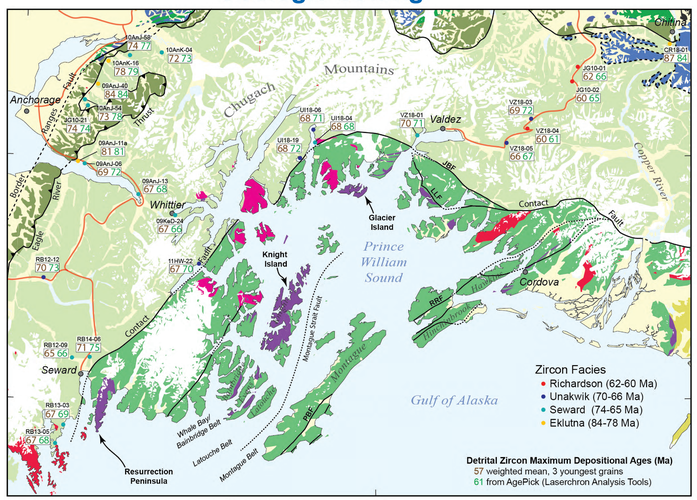

Figure 1. Geologic map of Prince William Sound, Alaska (modified from Bradley and Miller, 2006).

The Valdez and Orca Groups are both part of the Chugach-Prince William terrane (CPW), which is a thick accretionary complex that extends 2200 km along the southern Alaskan continental margin (Fig. 1; Cowan, 2003). This study is an investigation into the age and provenance of the Valdez Group and its relationship with the Orca Group in the central Chugach Mountains using detrital zircon U-Pb dates.

References

Bradley, D.C., and Miller, M.L., 2006, Field guide to south-central Alaska's accretionary complex, Anchorage to Seward: Anchorage, Alaska Geological Society, 32 p.
Cowan, D.S., 2003, Revisiting the Baranof-Leech River hypothesis for early Tertiary coastwise transport of the Chugach-Prince William terrane: Earth and Planetary Science Letters, v. 213, p. 463-475.
Fisher, W.S., Pope, M.D., Malik, A.M., Garver, J.I., and Davidson, C., 2019, Zircon facies in the Paleocene-Eocene Orca Group indicate a provenance link to the Chugach terrane, Prince William Sound, Alaska: Geological Society of America Abstracts with programs, v. 51, Portland, OR.
Malik, A.M., Fisher, W.S., Gross Almonte, N., Garver, J.I., and Davidson, C., 2019, U-Pb dating of detrital zircon from turbidites of the Chugach and Prince William terranes in Prince William Sound, Alaska: Implications for the significance of the Contact fault system as a terrane boundary: Geological Society of America Abstracts with programs, v. 51, Portland, OR.
Plafker, G., Moore, J.C., and Winkler, G.R., 1994, Geology of the southern Alaska margin, in Plafker, George, and Berg, H.C., eds., The geology of Alaska: Geological Society of America, DNAG Series, v. G-1, p. 389-449.

U-Pb Dating of Detrital Zircons

Valdez Group samples are dominated by Early to Late Jurassic, Early to Late Cretaceous, and Paleocene populations with their MDAs ranging from 84.1 to 59.8 Ma. We divide the range of MDAs into different clusters by reason of age breaks in the MDAs; the MDAs were concentrated in three clusters: 84-78 Ma, 74-65 Ma, and 62-60 Ma (Fig. 2). Each cluster of samples share similar grain-age distributions (Fig. 3) and is supported by the Kolmogorov-Smirnoff (K-S) test.

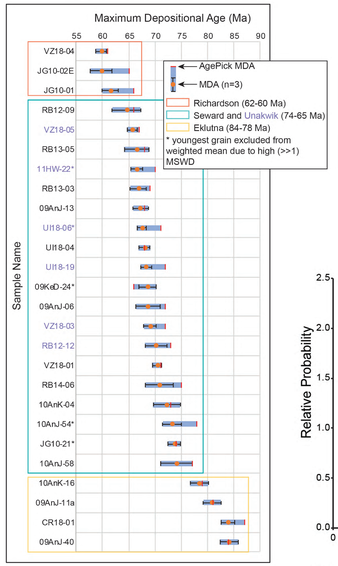

Figure 2. Maximum depositional ages (MDAs) of Valdez Group turbidites in Prince William Sound. MDA (n=3) is the weighted mean of the three youngest coherent zircons from a sample, and AgePick MDA was determined using the AgePick macro of Gehrels (2012). Blue bars show the range of uncertainty of the MDA for a sample.

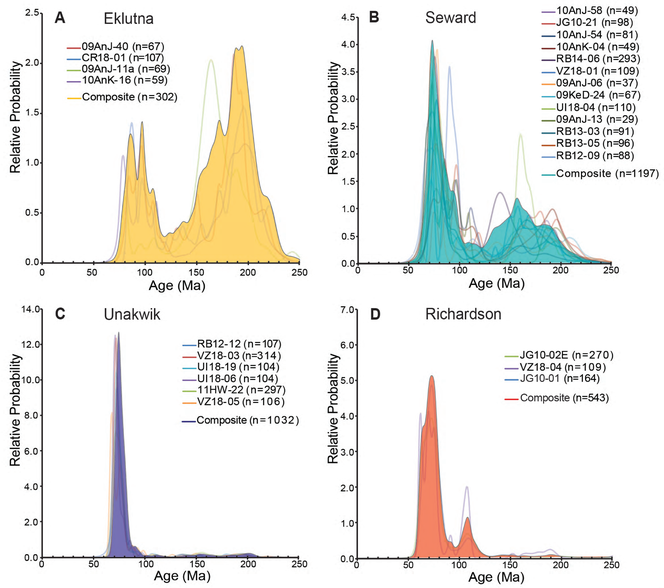

Figure 3. Normalized probability density functions (PDFs) of detrital zircon U/Pb ages for the four zircon facies identified in the Valdez Group. Filled PDFs are composites of all samples in a facies. Legends are organized from oldest to youngest MDA in the group. (A) Eklutna facies with MDAs between 84-78 Ma. (B) Seward facies with MDAs between 74-65 Ma. (C) Unakwik facies with MDAs between 70-66 Ma. (D) Richardson facies with MDAs between 62-60 Ma.

Discussion

The Eklutna (84-78 Ma), Seward (74-65 Ma), and Unakwik (70-66 Ma) facies of the Valdez Group are consistent with the notion that the Valdez Group is as old as Campanian and Maastrichtian. The Richardson (62-60 Ma) facies, though, is Paleocene and age-correlative with the Orca Group although the three samples (JG10-01, JG10-02E, and VZ18-04) were collected along Richardson Highway, an area long-mapped as Valdez Group. A comparison of the Richardson facies of the Valdez Group with the Miners Bay facies (which includes the three samples that comprise the Richardson facies) of the Orca Group (Fisher, 2019) shows that these units are nearly identical (Fig. 4).

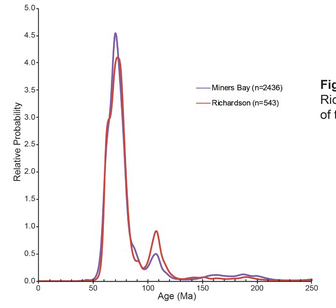

Figure 4. Normalized probability density functions of the Richardson facies of the Valdez Group and Miners Bay facies of the Orca Group.

We have two options for the occurrence of Orca Group age-correlative samples in areas mapped as the Valdez Group: (1) the Richardson facies is part of the Valdez Group and is stratigraphically equivalent to the oldest Orca Group (Miners Bay facies); or (2) the Richardson facies is part of the Orca Group and occurs in the Valdez Group as structural slices (Fig. 5A) or was deposited unconformably on top of the Valdez and subsequently folded into the Valdez Group (Fig. 5B).

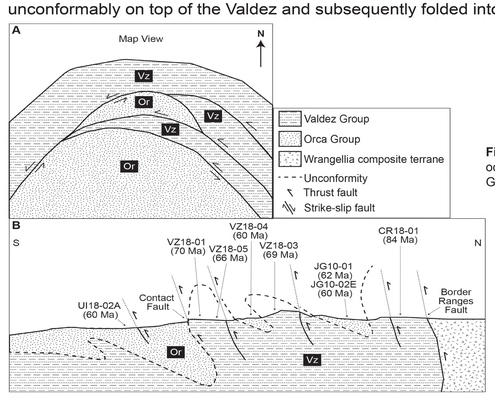

Figure 5. Two possible structural explanations for the occurrence of the young Richardson facies in the Valdez Group.

Key Points

- MDAs and grain-age distributions from the Valdez Group form four zircon facies: Eklutna (84-78 Ma), Seward (74-65 Ma), Unakwik (70-66 Ma), and Richardson (62-60 Ma).
- The Richardson facies overlaps in age with the Miners Bay facies from the Orca Group (Fisher et al., 2019).
- The Valdez Group is Upper Cretaceous to Paleocene in age, younger than previously thought.

Acknowledgments

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