

# **A Comprehensive and Integrated Provenance Analysis of the Dezadeash Formation (Jura-Cretaceous), Yukon, Canada: Constraints on the Accretionary Tectonic History of the Wrangellia composite terrane in the Northern Cordillera of North America**

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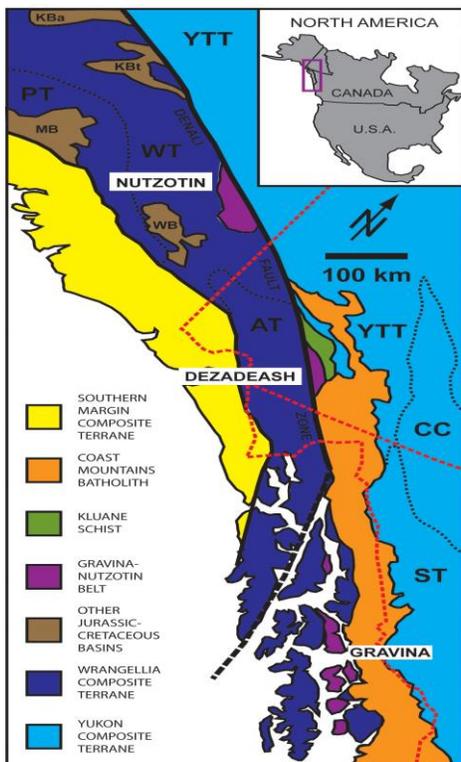
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## **Summary**

Provenance analysis, including conglomerate pebble counts, sandstone point counts, detrital zircons, and lithochemistry of sandstone, mudstone and hemipelagite beds, indicates that siliciclastics in the Dezadeash Formation were derived from a westerly source (i.e., primarily a magmatic arc), and does not support a retroarc foreland basin interpretation for the Nutzotin-Dezadeash basin (i.e., there is no evidence for an easterly derived craton / North American margin source).

## **Introduction**

The Wrangellia composite terrane, consisting of the amalgamated Wrangellia, Alexander and Peninsular tectonostratigraphic terranes, was the last microcontinent accreted to the western margin of North America, which consisted of the variably amalgamated Yukon composite terrane (i.e., Yukon-Tanana, Stikine, Quesnel and Cache Creek terranes). Accretion was accompanied by the formation of several Mesozoic magmatic arcs across the Wrangellia composite terrane, termed the Talkeetna (200-180 Ma), Chitna (160-140 Ma) and Chisana (120-100 Ma), and the collapse of intervening 'flysch' basins referred to as the Gravina belt, the Nutzotin Mountains sequence - Dezadeash Formation, and the Kahiltna assemblage.



**South Margin Composite Terrane**

Cenozoic subduction zone complex

**Coast Mountains Batholith**

Cenozoic plutonic rocks

**Kluane Schist**

Biotite schist of unknown age or protolith

**Gravina-Nutzotin Belt**

Jura-Cretaceous Gravina Belt and Nutzotin Mountains sequece - Dezadeash Formation

**Other Jurassic-Cretaceous Basins**

KBa and KBt- Kahiltna basin  
WB- Wrangell Mountains basin  
MB- Matanuska Valley basin

**Wrangellia Composite Terrane**

Paleozoic oceanic platform and Mesozoic arc-related rocks (Alexander, Wrangellia and Peninsular terranes)

**Yukon Composite Terrane**

Paleozoic pericratonal rocks (Yukon-Tanana terrane) and Mesozoic arc-related rocks (Stikine, Quesnel and Cache Creek terranes)

Figure 1

The 3000 m thick Dezadeash Formation represents submarine fan sediments (Lowey, 2007) interpreted as being deposited in a transtensional backarc basin (Berg et al., 1972). The 3000 m thick Nutzotin Mountains sequence also represents submarine fan sediments, which were recently interpreted as forming in a retroarc foreland basin (Manuszak et al., 2007; Trop and Ridgway, 2007). However, the Dezadeash Formation is located north of the Denali fault system and closer to the Yukon composite terrane, whereas the Nutzotin Mountains sequence is located south of the fault system and farther from the Yukon composite terrane. As both units represent the same basin displaced by ~370 km of dextral movement on the Denali fault system in post-Early Cretaceous time (Eisbacher, 1976, Lowey, 1998), evidence linking strata of the Nutzotin-Dezadeash basin with the Yukon composite terrane - representing the mid-Mesozoic margin of North America - is critical to the retroarc model. The purpose of this study is to determine if a depositional and compositional link exists between the Dezadeash Formation and the Yukon composite terrane.

**Methods**

The data set consists of 75 sedimentological sections throughout the Dezadeash Formation in southwestern Yukon. Just over 16 km of strata were measured, from which about 150 samples were collected. Analyzed samples (n) include conglomerate (n=3 pebble counts), sandstone (n=30 point counts, n=2 detrital zircons, n=25 major, trace and rare earth elements, and n=5 Sm-Nd isotopes), mudstone (n=6 major, trace and rare earth elements, and n=5 Sm-Nd isotopes), and hemipelagites (n=5 major, trace and rare earth elements, and n=3 Sm-Nd isotopes).

## Results

Conglomerate compositions (pebble counts) and sandstone compositions (point counts) document an undissected to transitional arc provenance, and detrital zircons from sandstones peak at ~157 Ma, the same age as the Chitina arc (Lowey, 2001). The Chemical Index of Alteration (based on major-element compositions) indicates that sandstones are relatively unweathered and mudstones are moderately weathered, whereas hemipelagites appear to be non-weathered. Chondrite normalized rare-earth element diagrams for sandstones, mudstones and hemipelagites demonstrate enrichment in light rare-earth elements and a lack of Eu anomalies, while Th/Sc and Th/U ratios suggest a young, undifferentiated arc provenance sourced from the depleted mantle. Trace-element and rare earth-element diagrams of Th/Sc versus Th/U for sandstones and mudstones indicate that element abundances in the Dezadeash Formation are due to variations in the source area rather than sediment recycling or sorting, whereas diagrams of La versus Th and La-Th-Sc for sandstones and mudstones further establish an island arc provenance. Lastly, epsilon Nd versus Age plots for sandstones and mudstones indicate the Wrangellia composite terrane as the provenance (Figure 5), whereas several hemipelagites have a slightly older crustal source.

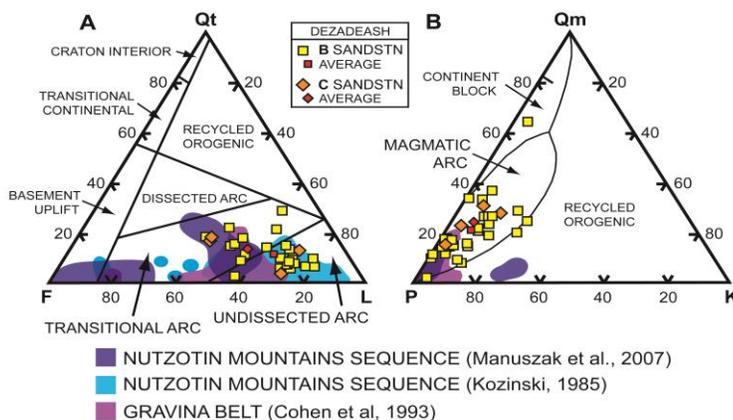


Figure 2

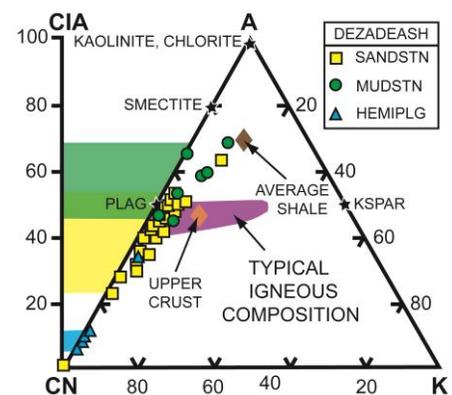


Figure 3

## Conclusions

Collectively, the provenance data indicates that siliciclastics in the Dezadeash Formation consist of first-cycle volcanogenic material derived from an undissected to transitional arc. Volcanogenic material was sourced from the depleted mantle as well as some older crustal material (i.e., the Wrangellia composite terrane proxying for continental crust). Only the coeval Chitina arc plus the Wrangellia composite terrane acted as the source. However, the non-weathered hemipelagites appear to have a more evolved source. The provenance data, combined with paleocurrent data that indicates *exclusively* a westerly source, does not support a retroarc foreland basin interpretation for the Nutzotin-Dezadeash basin.

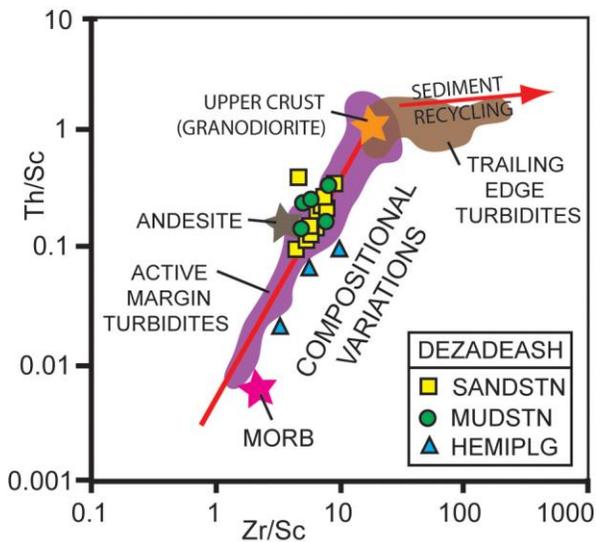


Figure 4

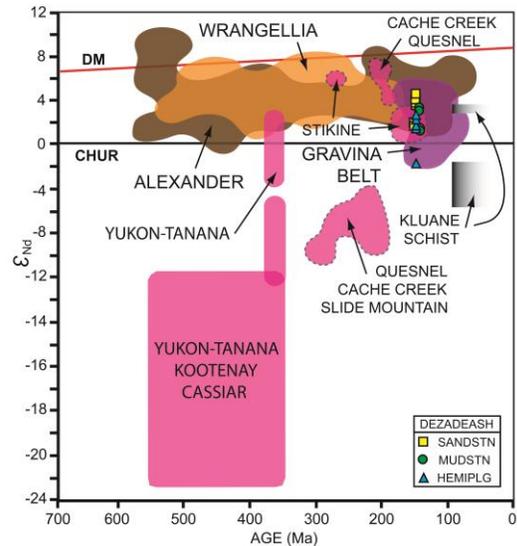


Figure 5

## Acknowledgements

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