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Caledonides to Cascades Connections: Tectonic evolution of Paleozoic terranes in NW Washington, USA

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A growing body of evidence suggests terranes presently on the west coast of North America in the Klamath Mountains (California), Cascades Mountains (Washington), and in southeast Alaska originated in the paleo-Arctic realm of Baltica and the Caledonides. Migration to their present sites and final emplacement on the margin during the Mesozoic are poorly understood processes. New field, U-Pb, and Lu-Hf data constrain the geologic history, age, and origin of the Yellow Aster Complex (YAC) in NW Washington, and suggest that this Paleozoic arc terrane originated along the paleo-Arctic margin of NE Laurentia. Field work shows the oldest YAC consists of quartzo-feldspathic paragneiss (meta-arkosic sandstone and conglomerate) and quartzose calc-silicate gneiss (meta-calcareous siltstone) in gradational contact. Paragneisses are cut by syn- and post-tectonic intrusions, and faulted against granitic orthogneiss. U-Pb results show that 1) maximum depositional ages of paragneisses are Silurian to early Devonian (399 to 434 Ma); 2) quartzose calc-silicate gneisses show a broad age peak from 1000-1900 Ma, while quartzofeldspathic gneisses contain several distinct Precambrian age peaks, including at 1.8-2.0 Ga and 2.4-2.5 Ga; 3) Both gneisses contain early Paleozoic grains with peaks at ~400-420 and ~450-460 Ma; 4) pre-tectonic orthogneiss and syn- and post-tectonic dikes range from 410 to 398 Ma; 4) All intrusive rocks contain apparently xenocrystic ~450 Ma grains.

Lu-Hf isotope data show that nearly all Paleozoic grains have negative epsilon Hf values, and zircons in the meta-arkose samples are more highly evolved than those in the calc-silicate. Several meta-arkose samples yield epsilon Hf values of -40 to -50, which is rare in the North American Cordillera, and requires the involvement of Early Archean crustal components. The most likely source region with Early Archean crust and early Paleozoic magmatism is Greenland, which implies derivation from the paleo-Arctic margin of northeastern Laurentia or Baltica. The chemistry and petrology of the igneous rocks suggest the terrane was in a continental arc setting during or very shortly after deposition of the sedimentary rocks. The data suggest that sedimentation, deformation, metamorphism, and magmatism all occurred within a brief (~15 m.y.) period in the early Devonian. These relationships suggest a Caledonian origin for YAC prior to translation to the Cordillera. Although our prior work suggested connections to Turtleback complex (San Juan Islands) and Alexander terrane (Karheen formation) based on U-Pb data, Hf data appear to rule out such connections. However some elements of Alexander terrane (St Elias and Banks Island) are similar to YAC, and further work is needed to resolve the links. We hypothesize that YAC was faulted into the Northwest Cascades Thrust System during Cretaceous time during or following sinistral faulting and southward displacement and disruption of the Alexander terrane.

