The growth of the CCArray Observational network in western Canada

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A succession of tectonic events, spanning more than two billion years, has shaped the Canadian Cordillera as a distinct physiographic province within the actively deforming western margin of North and South America. The diverse terranes, faulting, and deformation in western Canada make it a natural laboratory for examining rifting, subduction, terrane accretion, transtension, mountain building, and continental evolution. The paucity of broadband seismic observations in western Canada also distinguish it from the widespread, and regular, seismic sampling of the EarthScope Transportable Array, which has been deployed across the contiguous United States and Alaska. Building on the momentum and success of the EarthScope and the Canadian Lithoprobe programs, the CCArray (Canadian Cordillera Array) program plans to examine this incompletely understood boundary of North America by constructing a network of observatories that will collect seismic, geodetic, and other geologic data (Figure 1). Systematically investigating the structure and dynamics of the Canadian Cordillera will help address major challenges central to resource development, energy security, and geohazard mitigation facing Canada in the 21st century.

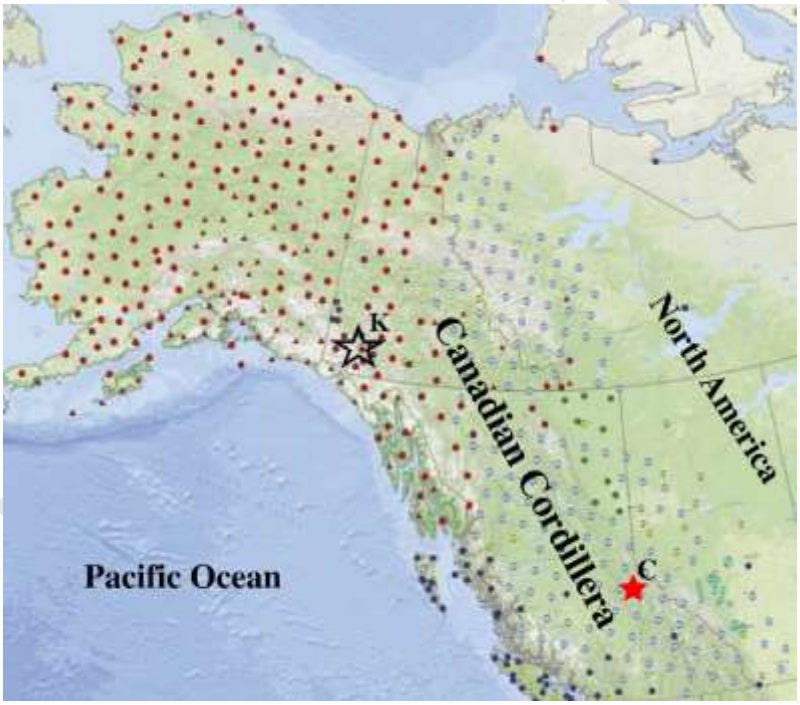

Figure 1. Locations of seismic stations in western North America: EarthScope (red circles) and proposed CCArray (gray) networks. Kluane Lake and Canoe Reach are labeled K and C respectively.

The suite of geophysical observations collected by CCArray will be used to gain insight into the dynamics and evolution of the western margin of the North American plate and episodes of current and past of deformation. These data will also provide constraints for focused investigations with immediate societal needs such as climate-related hazards, water resources, and induced seismicity, by identifying relationships between the distribution of earthquakes, tectonic features, and industrial activity. Improving our understanding of the crust and upper mantle of the Canadian Cordillera will also help to identify the faults or other pathways used by geothermal fluids and metal-bearing magmas, which will aid in characterizing

regional mineral systems and the development of natural resources.

Through developing collaborations with EarthScope, GFZ and industry, the growth of CCArray has initiated with its first permanent seismic station deployed at the Kluane Lake Research Station (Figure 1). Data are also being contributed by other existing seismic arrays as well as temporary stations, such as those that have been deployed around the Canoe Reach Geothermal Field within the Rocky Mountain Trench (Figure 1). Canoe Reach serves as an example where new seismic data contributes to natural resource development and provides constraints on the lithospheric structure and dynamics.

Earlier observations of crustal structure of the cordillera found it to possess thin crust compared to the interior of North America, and this change in thickness to occur near the Rocky Mountain Trench. We are now able to refine our understanding of the crustal structure in the trench using data from Canoe Reach, which is a portion of the trench that has not been sampled previously. Examining this geothermal field has revealed low levels of seismic activity on faults in the trench by detecting small earthquakes. The diffuse nature of this activity suggests that fluids within the geothermal field do not circulate through a single well-developed fault zone and are instead traveling through a more broadly distributed series of fractures.