New constraints on inner core anisotropy structure from data recorded at newly deployed seismic stations in Antarctic

Xinlei Sun, Douglas A. Wiens, Audrey Huerta, Rick Aster, Andrew Nyblade and Sridhar Anandakrishnan

The Earth's inner core structure is important for understanding the evolution and dynamics of the Earth. Seismological studies generally agree that the anisotropy structure of the inner core is complicated and it may vary laterally and with depth. However, the anisotropy structure of the central part of the inner core remains a matter of dispute, in part because few PKPDF travel times have been recorded at near-antipodal distances along the fast axis of inner core anisotropy, which is approximately aligned with the Earth's spin axis. Such recordings require sources near one of the earth's poles and seismographs near the other, a path geometry that is rare given permanent station locations and the distribution of seismicity.

We present here a unique PKP data set recorded at newly deployed seismic arrays in Antarctic: the Antarctic's Gamburtsev Province (AGAP) project and the Polar Earth Observing Network (POLENET). These networks now provide an additional ~ 40 broadband seismic stations on the Antarctic interior where the global network has only South Pole station. The PKP data recorded at these stations from earthquakes in the north hemisphere are at a distance range from 120 to nearly 180 degrees, with the raypath directions sub-parallel to the Earth's rotation axis. This data set provides a more uniform sampling of the inner core at both hemispheres, especially at near antipodal distances and near north-south directions.

We have analyzed part of the PKPDF and PKPAB travel times from 145 to 180 degrees. The AB and DF travel times are determined separately for each event using an iterative waveform correlation method. Mantle heterogeneity and ice thickness effects are also corrected. Our preliminary results show that the fast PKPDF residuals increase consistently from about -1 to -11 seconds as distance increases, and in general, PKPDF is 2-6 s faster than PKPAB at distances greater than 150 degree. PKPAB-DF differential residuals, on the other hand, increase from about 4 to 8 seconds as distance increases. Meanwhile, PKPAB-DF residuals display clearly hemispherical differences to at least 700 km below the inner core boundary, with those sampling the eastern hemisphere about 2 seconds slower that those sampling the western hemisphere. On average, the PKPAB-DF residuals suggest the anisotropy amplitude for the eastern and western hemisphere is 3.1% and 1.8% , respectively, if the travel time residuals are assumed to result from the inner core anisotropy. We also find that although the PKPDF residuals are more anti-correlated with the PKPAB-DF residuals, there are differences in the amplitude of the two sets of residuals,

indicating the crustal structure of the Antarctic is not negligible when using the absolute PKPDF travel times.

In the future we plan to add more PKP data at smaller distances and make better corrections for receiver-side mantle and crust structure using recently derived models of the Antarctic continent. This data set, together with other data set from global networks, will provide a more reliable model of inner core anisotropy structure.