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The relationship between climate and ice rheology at Dome C, East Antarctica: a comparison of fabric determined by borehole sonic logging and thin sections.

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Understanding past climate changes as recorded in annual layers within ice sheets is a societal and scientific priority. Oxygen isotopes from several deep ice-cores in Greenland and Antarctica have revealed oscillations with a $\sim$ 100 kyr periodicity extending back at least 740 kyr BP. The EPICA Dome C ice core, the longest climate record obtained from ice, records eight glacial-interglacial transitions where abrupt climate transitions typically separate warm periods (interglacial) from cool periods (glacial). These warm and cool periods are referred to as Marine Isotope Stages (MIS).

Many scientists have observed that the physical properties of glacial ice differs from those of interglacial ice. Glacial ice typically has smaller crystals, higher impurity content, and stronger fabric (preferred orientation of crystal c-axes). Because ice deformation is sensitive to the orientation of crystals, ice flow patterns are sensitive to the fabric and, therefore, to this glacial-interglacial dichotomy. Indeed at Dome C an abrupt, unexpected strengthening of the fabric at the depth of 1750 m marks the transition between the warm MIS5 and the cold MIS6. Because there is a positive feedback between fabric development and ice deformation, changes in ice fabric may be therefore used to understand climate transitions.

We present a vertical-profile of compressional (P) wave speeds acquired every 0.1m in the 3.2 km-deep EPICA Dome C borehole. Each measurements samples ice crystals within a volume approximately 3 m long and 2 m wide ice. We relate the P-wave speeds to fabric through the known seismic anisotropy of a single ice-crystals (P-wave speed is 5% faster when propagates along the crystallographic c-axis than the basal plane). We integrate this seismically-derived fabric profile with the more sparse ($\sim$ 100 m for most of the core) thin-section-derived fabric to present a more complete vertical-profile of fabric. We provide a preliminary comparison of the shifts in fabric which occur at each of the abrupt climate transitions and relate these to other measurements made on the ice core and in the borehole such as dust and oxygen isotopes.