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Ice Core Science at the three Poles

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KEYNOTE: The Oldest Ice Challenge, lessons from the site selection at Little Dome C

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The quest for an ice record covering 1.5 million years is a challenge that has driven the ice core community for more than a decade. A first key issue is the site selection and the progress made on this point has been striking, leading to the selection of suitable sites in the Little Dome C region, with reasonable confidence both in term of age reached and on the needed resolution to preserve climatic signal in the deepest ice. This presentation aims to recall how this goal was achieved and the importance of combining different types of measurements and modeling. The role of the iterative approach, with a re-evaluation of the areas to be surveyed at each step, will be emphasized.

The approach can be compared to a succession of zoom-ins from the very large scale down to the scale of a few hundred meters. The initial criteria, based on ice thinning equation and heat equation, were very useful for the first step, which led to the selection of the central regions of East Antarctica with relatively thin ice and the hope of a not too strong geothermal flux. On smaller scales, additional data were needed, not only to obtain the subglacial topography but also to confront with the reality of the ice flow (not as simple as the approximated equations of the beginning) and the thermal conditions at the ice-bed interface depending on a poorly known geothermal flux.

This presentation will recall the various measurements done : radars, internal layers identification and dating, ice velocity, anisotropy assessment, drilling and temperature measurement, … and how analyzing this heterogeneous set of data in a modelling framework increased our confidence in the chosen site. We will also highlight the glaciological advances that result from this work such as the observation of a "basal unit" at Little Dome C consistent with the suggestion of stagnant basal ice from internal layer inversion and the fact that very small scale features are crucial when the target is that old. These findings can potentially shift the frame for presently ongoing or future pre-site survey for comparable targets, as the boundary conditions can be slightly relaxed when it comes to basal properties.
Finally, we will recall the technical progress generated by this quest.

Authors: RITZ, Catherine (IGE, University of Grenoble Alpes, CNRS); CAVITTE, Marie (UCLouvain); EISEN, Olaf (Alfred Wegener Institute); FREZZOTTI, Massimo (Department of Science, University of Roma Tre); MARTIN GARCIA, Carlos (British Antarctic Survey); MULVANEY, Robert (British Antarctic Survey); PARRENIN, Frédéric (CNRS/IGE); RIX, Julius (British Antarctic Survey); ROBERTS, Jason (Australian Antarctic Division); Prof. VITTUARI, Luca (Univeristy Bologna, Italy); YOUNG, Duncan (Institute for Geophysics, University of Texas at Austin, Austin, TX 78758, USA); VAN LIEFFERINGE, Brice (Laboratoire de Glaciologie, Université libre de Bruxelles, Brussels, Belgium)

Presenter: RITZ, Catherine (IGE, University of Grenoble Alpes, CNRS)

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