

The Beyond EPICA – Oldest Ice Core Project

BARBARA STENNI¹, FRANK WILHELMS^{2,3}, JULIEN WESTHOFF⁴, OLIVIER ALEMANY⁵, STEFEN BO HANSEN⁴, DORTHE DAHL-JENSEN⁶, HUBERTUS FISCHER⁷, AMAELLE LANDAIS⁸, AILSA CHUNG⁵, FRED PARRENIN⁵, CARLO BARBANTE¹, MRS. LISA ARDOIN⁹, MELANIE BEHRENS¹⁰, GIANLUCA BIANCHI FASANI¹¹, NICOLAS BIENVILLE⁸, MARIE BOUCHET⁸, GRANT BOECKMANN⁴, PIERRE-HENRI BLARD¹², PASCAL BOHLEBER^{10,13}, ANDREA CEININI¹⁴, GIUDITTA CELLI¹, DANILO COLLINO¹⁴, GIULIO COZZI¹³, REMI DALLMAYR¹⁰, ANDREA DE VITO¹⁴, GIULIANO DREOSSI¹, ROMAIN DUPHIL⁵, OLAF EISEN^{2,15}, FRANÇOIS FRIPIAT¹⁶, INÈS GAY¹⁷, TAMARA GERBER^{4,18}, VASILEIOS GKINIS⁴, MARKUS GRIMMER⁷, ROMILLY HARRIS-STUART⁸, MARIA HÖRHOLD¹⁰, MATTHIAS HÜTHER², DANIELA JANSEN², FORTUNAT JOOS⁷, PETER KOEHLER², IBEN KOLDTOFT⁴, FLORIAN KRAUSS⁷, MANUELA KREBS², THOMAS LAEPPLÉ², GUNTHER LAWER², JOHANNES LEMBURG², MARTIN LEONHARDT², CARLOS MARTIN¹⁹, HANNO MEYER², BÉNÉDICTE MINSTER⁸, MICHAELA MÜHL⁷, ROBERT MULVANEY¹⁹, SAVERIO PANICHI¹⁴, PHILIPPE POSSENTI⁵, CATHERINE RITZ⁵, RACHAEL RHODES²⁰, MICHELE SCALET¹⁴, FEDERICO SCOTO¹³, BARBARA SETH⁷, LISON SOUSSAINTJEAN⁷, HANS CHRISTIAN STEEN-LARSEN²¹, THOMAS STOCKER⁷, JAKOB SCHWANDER⁷, JEAN-LOUIS TISON¹⁶, CLARA TURETTA¹³, JAMES VEALE¹⁹, CHIARA VENIER¹³, ILKA WEIKUSAT^{2,22}, MARTIN WERNER², ERIC WOLFF²⁰ AND DANIELE ZANNONI¹

¹Ca Foscari University of Venice, Italy

²Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung, Germany

³Georg-August-Universität, Germany

⁴University of Copenhagen, Denmark

⁵Université Grenoble Alpes, France

⁶University of Manitoba, Canada

⁷University of Bern, Switzerland

⁸LSCE - Institut Pierre Simon Laplace, France

⁹Laboratoire de Glaciologie, Université Libre de Bruxelles, Belgium

¹⁰Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research

¹¹ENEA, Rome, Italy

¹²CRPG, CNRS, Université de Lorraine, France

¹³CNR Institute of Polar Sciences, Venice, Italy

¹⁴ENEA, Bologna, Italy

¹⁵University of Bremen, Germany

¹⁶Laboratoire de Glaciologie, Université Libre de Bruxelles (ULB)

¹⁷Institut polaire français Paul-Emile Victor, France

¹⁸Université de Lausanne, Switzerland

¹⁹British Antarctic Survey, Cambridge, United Kingdom

²⁰University of Cambridge, United Kingdom

²¹Universitetet i Bergen, Norway

²²Eberhard Karls University, Tübingen, Germany

The Beyond EPICA – Oldest Ice project in East Antarctica marks a groundbreaking milestone in unraveling Earth's past climate dynamics. Recent findings confirm that the paleoclimatic record extends back at least 1.2 million years, offering unprecedented opportunities to explore glacial interglacial cycles and the mechanisms driving Earth's climate system. To better constrain the long-term response of Earth's climate system to continuing greenhouse gas emissions, it is essential to turn to the past. A key advance would be to understand the shift in Earth's climate response to orbital forcing during the 'Mid-Pleistocene transition' [MPT, 900,000 (900 kyr) to 1.2 million years (1.2 Myr) ago], when a dominant 40 kyr cyclicity gave way to the current 100 kyr period. It is critical to understand the role of forcing factors and especially of greenhouse gases in this transition. Unravelling such key linkages between the carbon cycle, ice sheets, atmosphere and ocean behaviour is vital, assisting society to design an effective mitigation and adaptation strategy for climate change. Only ice cores contain direct and quantitative information about past climate forcing and atmospheric responses. Drilling operations reached the bedrock at a depth of 2800 meters, granting access to ancient ice. High-resolution analyses of hydrogen isotopes (δD) were conducted, with sampling resolutions down to 25 cm, providing unparalleled insights into climate and environmental fluctuations. Concurrently, dielectric profiling (DEP) measurements were employed to identify detailed climatic stratifications within the ice core. This presentation will highlight the main results achieved so far, emphasizing their implications for understanding the transition of glacial cycles from 40,000 to 100,000 years and the long-term evolution of greenhouse gas concentrations. By bridging critical gaps in our knowledge of paleoclimate, this work also establishes a robust basis for modeling future climate scenarios, reinforcing the importance of understanding Earth's climatic past to inform predictions of its future.