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Temporal and spatial 17O-excess variations reflect changes in the hydrological cycle except in remote central east Antarctica

Renato Winkler (1), Amaelle Landais (1), Frédéric Prié (1), Barbara Stenni (2), Andrew Moy (3,4), Tas Van Ommen (3,4), Elise Fourré (1), Philippe Jean-Baptiste (1), Jean-Jacques Beley (5), and Jean Jouzel (1)

(1) Laboratoire des Sciences du Climat et de l'Environnement, DSM / LSCE, France (renato.winkler@lsce.ipsl.fr), (2) University of Trieste, Department of Geosciences, 34127 Trieste, ITALY, (3) Australian Antarctic Division, Kingston, Tasmania 7050, AUSTRALIA, (4) Antarctic Climate & Ecosystems Cooperative Research Centre, University of Tasmania, Hobart, Tasmania 7001, AUSTRALIA, (5) Danone, R&D Water Division, FRANCE

For many decades stable water isotopes (δD and δ^{18}O) have been used as tracers of the earth's hydrological cycle in order to get information about climatic parameters. In the low latitudes, water isotopes trace precipitation rate (amount effect), history of air masses, regional convection or water vapor transport. In higher latitudes, δD and δ^{18}O are directly linked to condensation temperature at first order while the combination of both in d-excess

[= δD – 8 δ^{18}O] gives indication on source climatic conditions. The recent development of ^{17}O-excess [= ln(δ^{17}O + 1) – 0.528ln(δ^{18}O + 1)], resulting from the combination of δ^{17}O and δ^{18}O, now provides an additional isotopic tracer which has been shown to be primary influenced by relative humidity at evaporation. Here, we show new results of ^{17}O-excess in precipitation from tropical to polar regions which better characterize the link between hydrological cycle and climate at the different locations based on the ^{17}O-excess signature.

First, we present a compilation of ^{17}O-excess on natural water sources in France, Turkey, Mexico and Argentina from precipitation and groundwater and show that the ^{17}O-excess signature helps to decipher the different sources of water. Then, we compare the ^{17}O-excess variations over the deglaciation in Antarctica from 4 different ice cores (2 coastal ones: TALDICE and LAW DOME – DSS; 2 central ones: EPICA DOME C and Vostok) which show different behaviours. While the ^{17}O-excess record from the coastal ice cores seems to faithfully record the variations of relative humidity at the source regions providing moisture to Antarctica, the ^{17}O-excess record in central East Antarctica seems to be affected more by local effects. In order to further constrain the local variations of ^{17}O-excess in remote central east Antarctica, we explore the interannual ^{17}O-excess variations from a snow pit at the Vostok station.

These new ^{17}O-excess results of the European and South American continents, together with the data from Antarctica, span a wide range of very different climatic conditions and therefore allow us to test our current understanding of ^{17}O-excess.