

Europlanet TNA Report

PROJECT LEADER

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COLLABORATORS

Name:	Affiliation:
Date of TNA visit:	15-19 February 2010
Host laboratory:	CRPG- Stable Isotope facility

Project Title – Deuterium excess: a proxy of water origin (DEU-POWER)

- Report on the outcomes of the TNA visit (approx 1 page)

During the TNA visit, 101 deuterium/hydrogen (D/H) and 13 18O/16O ratios of river and ground water from Taiwan, Iran, Greece and Greenland have been measured together with a set of standards in order to obtain a very careful and detailed calibration of the methods. The investigated samples cover about 45% of the natural variation in the isotopic composition of terrestrial waters. A lot of care has been devoted to the analysis of the D/H ratio. The reproducibility on samples is 1.84‰ (at 2 σ level, N=9) and compares well with the reproducibility on the standards (2 σ = 1.71‰, N=95) and the internal precision of the measurements (average 2 σ = 1.85‰, N=206). The accuracy of the method has been validated by the measurement of SMOW, SLAP and GISP water that returned data within 0.04‰ of their certified values, on average. The TNA uses the coupling between an elemental analyser and an isotope ratio mass spectrometer (EA-IRMS) for the measurement of the variation in the D/H ratio of water molecules. This method has been compared with data obtained by Cavity Ring-Down Spectroscopy (CRDS), in the Godwin Laboratory for Palaeoclimate Research, in Cambridge. A sub-set of samples have been measured by this technique and the duplicate of 60 D/H and 9 18O/16O ratios have been obtained. The reproducibility of the CRDS was 0.12‰ and 0.65‰ (at 2 σ level, N=6) for D/H and 18O/16O, respectively. The difference between the 2 methods was 1.1 \pm 2.2‰ and 0.03 \pm 0.08‰ for D/H and 18O/16O, respectively. The CRDS is,

therefore, a method as accurate and as precise as the EA-IRMS, with the added advantage of measuring the D/H and $^{18}\text{O}/^{16}\text{O}$ ratios in one single run, saving time and potential error during manipulation of the samples. The CRDS method has been used to determine the deuterium excess (D_{excess}) of river water from Taiwan during a typhoon and to study the potential change in water provenance. 15 water collected between the 30th June 2007 and the 25th July 2007 have been measured. During that period of time, the D_{excess} was $14.2 \pm 1.35\text{‰}$ (at 2σ level) while variation of more than 17‰ was recorded by the D/H ratio. Such a small variability in the D_{excess} is well within the long-term reproducibility of the method and is at odd with the hydrographs and dissolved ions chemistry that suggest a significant change in the proportion of deep-water contribution throughout this typhoon. The constant D_{excess} in the river suggests a negligible contribution of soil water (characterised by a lower the D_{excess} related to the evapo-transpiration) to the deep aquifer. Further interpretation of the data obtained for the Greenland and groundwater from Taiwan are under consideration.

Please include:

- Publications arising/planned (include conference abstracts etc)

-Caroline Martin will be using some of the data acquired to write up her PhD thesis.
-The comparison of the EA-IRMS and the CRDS should be written up by the project leader and the head of the host laboratory for publication in an appropriate journal.
-The interpretation of the D_{excess} in river water from Taiwan during a typhoon will be presented by the project leader at the AGU, Fall meeting 2010, in an invited presentation. It is planned to be submitted for publication in the hydrological literature.

- Host approval The host is required to approve the report agreeing it is an accurate account of the research performed.