Holocene peat bog records of atmospheric dust fluxes in Southern South America

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Little attention has been given to Holcene pre-anthropogenic dust records in terrestrial environments, especially in the Southern Hemisphere. Yet they are important to 1/ better understand the different particle sources during the Holocene and 2/ to tackle the linkage between atmospheric dust loads and climate change and 3/ to better understand the impact of dust on Holocene palaeoclimate and palaeoenvironments in a critical area for ocean productivity. In the PARAD project, we explore the use of a broad range of trace elements and radiogenic isotopes (Pb, Nd) as dust proxies. By coupling these findings with biological proxies (plant macrofossils) and detailed age-depth modelling, we expect to identify and interpret new links between atmospheric dust chemistry and climate change. In this contribution, we will present the elemental and isotopic signatures of two peat records from Chilean and Argentinean Tierra del Fuego, covering the Holocene. We provide here the first high-resolution dust flux records for the Southern South American Holocene. Results will also encompass density, ash content, grain size analyses, macrofossil determination and radiocarbon age modelling. Preliminary linkage of dust fluxes with change in vegetation and climate can be seen in our results. Single dust peaks originate from volcanic events while others are to be explained by regional to long range dust transport from Southern South dust source (local soils, glaciers, fluvioglacial plains, dry lakes and valleys and perhaps, pampa materials).

High performance reactive transport simulation of hyperalkaline plume migration in fractured rocks

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Integration of hydrogeology and geochemistry is crucial for several problems in Earth Sciences and Engineering. One of the challenges for such integration is the large amount of computational resources needed due to the high non-linearity of the resulting system of equations. Taking advantage of new developments of powerful numerical tools, and based on high performance parallel computing, the solution of regional-scale hydrogeochemical models has become possible. A software solution, denoted iDP, has been developed which serves as an interface between DarcyTools [1] and PFLOTRAN [2]. The project is financed by SKB, the Swedish Nuclear Fuel and Waste Management Company. iDP has been applied for the first time in the Mare Nostrum III, a new facility of the Barcelona Supercomputing Centre. A total of 25,000 processor cores during 5 days were used to solve a large-scale (100 Mcells), long-term (10,000 years) simulation of the hydrogeochemical behaviour of an hyperalkaline plume produced by the dissolution of grout used during the construction of a deep geological repository for spent nuclear fuel. The simulation integrates the complex 3D groundwater flow accounting for the Discrete Fracture Network (DFN) of the site, and the complexity of the geochemical system involved in cement grout dissolution and secondary minerals precipitation within the flowing fractures.

[1]. Svensson, U, Ferry, M. (2010) Darcy Tools version 3.4. User's Guide, SKB R-10-72 (available at www.skb.se)

[2]. Lichtner, P.C., Hammond, G.E., Bisht, G., Karra, S., Mills, R.T., and Kumar, J. (2013) PFLOTRAN User's Manual: A Massively Parallel Reactive Flow Code.

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DOI: 10.1180/minmag.2013.077.5.4