A multi-proxy record from a late Neoproterozoic volcano-sedimentary basin, eastern Arabian Shield

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Small, middle to late Ediacaran intermontane basins occur in the northern and eastern Arabian shield. The Jibalah basins are a subset of these basins that are minimally deformed and concentrated along the Najd strike-slip fault system, where they likely originated as pull-apart basins during the late stages of the East African orogeny. Whereas the Jibalah basins all appear to share similar sedimentary basin evolution and are broadly the same age, the nature of the basin fill is highly variable. The 10x50 km Jifn Basin, along the northwestern extent of the Halaban-Zarghat Fault Zone, has a carbonate-rich sedimentary succesion that was deposited between ~635 and 577 Ma. This succession includes a 340 m-thick shoaling upward section of mixed cherty limestone and dolostone, which overlies a basal, volcaniclastic conglomerate and in turn is overlain by a thick interval of medium- to coarse-grained arkosic sandstone. The carbonates are dominantly gravity flow deposits, transitioning upward into grainstones and heavily silicified microbial laminites—a facies that supplied many of the clasts to the deeper water gravity flow deposits. Felsic tuffs and tuffaceous siltstones, as much as 10 m-thick, occur throughout the succession. In several cases, these are directly overlain by a distinct sequence of organic-rich laminites, followed by rhythmites containing unusual, bubble-like (methane?) structures, and disrupted beds with evidence for fluid escape. We interpet the succession to record eutrophication of the water column following plinian volcanic eruptions. Here we report inorganic and organic C, O, S, and Sr isotopes, along with major and trace element abundances for the Jifn carbonates. We apply these proxies to evaluate the geochemical response in this small basin to massive input of volcanic material and to test its connection to the global ocean at a time of monumental environmental and biological change.

The ortho-para ratio of H_2O desorbed from ice: Implications for cometary coma

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H_2O contains two protons with nuclear spin of I=1/2, leading to two nuclear-spin isomers: the ortho (I=1, triplet, parallel nuclear spin) and the para (I=0, singlet, antiparallel nuclear spin) with statistical weights of 3 :1. The lowest energy level of ortho-H_2O lies about 34 K above the lowest para-level in the gas phase. Nuclear-spin temperature (T_{spin}) is defined by a given ortho-para ratio (OPR), because the OPR depends on temperature in local thermodynamic equilibrium. T_{spin} of H_2O has been observed in comet coma, and it has been derived to be ~30 K. Although the T_{spin} values have been implicated as a temperature of cold grains at molecular condensation or formation in a molecular cloud, or in the solar nebula, the correlation between T_{spin} and temperatures of ice at condensation, formation, and desorption is yet to be investigated. The present study measured the T_{spin} of H_2O that was thermally desorbed from amorphous solid water (ASW) at the desorption temperature for cometary water ices, 150 K. The ASW samples were prepared at 8 K by several procedures in an ultra-high vacuum chamber: H_2O-vapor-deposited ASW and ASW produced by photolysis of CH_4/O_2 mixed solid. The sample solids were then heated to 150 K and the thermally desorbed H_2O molecules were analyzed rovibrationally. Desorbed H_2O molecules from all ice samples were found to show T_{spin} almost at the statistical high-temperature limit, indicating that T_{spin} of gaseous H_2O molecules thermally desorbed from ice does not reflect the surface temperature at which H_2O molecules condense or form under laboratory conditions.

[1] Hama, T. *et al*, (2011) *ApJ,* **738**, L15 (5pp).

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