ENCELADUS' HYDROTHERMAL ACTIVITY: ANOTHER HABITABLE WORLD?. Y. Sekine[1], T. Shibuya[2], F. Postberg[3,4], S. Hsu[5], K. Suzuki[2,6], Y. Masaki[6], T. Kuwatani[7], S. Tachibana[8] [1]Dept. Complexity Sci. & Engr., Univ. Tokyo (5-1-5 Kashiwanoha, Kashiwa, Chiba 277-8561 Japan, sekine@k.u-tokyo.ac.jp), [2]Precambrian Ecosystem Lab., JAMSTEC, [3]Institut für Geowissenschaften, Univ. Heidelberg, [4]IRS, Univ. Stuttgart, [5]LASP, University of Colorado, Boulder, [6]Submarine Resource Res. Project, JAMSTEC, [7]Graduate School of Environment Studies, Tohoku Univ., [8]Dept. Natural History Sci., Hokkaido Univ.

A plume of vapour and water ice particles rich in sodium salts erupting from warm fractures near the south pole of Saturn's icy moon Enceladus suggest the presence of a liquid-water reservoir in the interior[1,2], which is or has been in contact with the moon's rocky core. The findings of silica nanoparticles in the E-ring originating from the plumes imply active geochemistry involving water-rock interactions[3,4]. However, the particular conditions of temperature and mineral compositions are yet unconstrained. Here we report laboratory experiments and calculations of hydrothermal reactions simulating Enceladus' interior. To achieve high silica concentrations in the fluids, which are sufficient for the formation of silica, hydrous silicates involving the water-rock interactions would be composed mainly of serpentine and saponite/talc, consistent with the rock components similar to carbonaceous chondrites. Fluid temperature needs to reach ≥100–200°C, suggesting hydrothermal activity in Enceladus. In contrast to previous reports[5,6], the lack of N_2 in the plumes[7] may be in good agreement with a warm interior because decomposition of NH_3 to N_2 would be kinetically inhibited even at 300°C. Our results support the idea that deep hydrothermal circulation in a warm core of Enceladus[5,8–10] drives hotspots in the H_2O mantle, possibly contributing large tidal dissipation and anomalous heat flow at the south pole[11,12]. To achieve such high temperatures in geologically recent past or today, Enceladus might have formed in ~4 Myrs after the formation of the solar system.

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