ISIS: AN APPARATUS WITH OPTICAL ACCESS FOR IN-SITU MEASUREMENTS TO 700 MPa. S. D. Vance, J.M. Brown, E.H. Abramson, Astrobiology Program and Department of Earth and Space Sciences, Box 351310, Seattle, WA 98195, E-mail: svance@ess.washington.edu.

Introduction: Improved knowledge of material properties under the novel pressure-temperature conditions obtained inside icy satellites may point to phenomena not found on Earth [1]. On Earth, high hydrostatic pressures (~150 MPa) are obtained in subsurface aquifers extending up to four km into oceanic crust. In other planetary objects, fluid circulation depth may be orders of magnitude greater, and corresponding hydrostatic pressures in these extended environments may be up to fifty percent greater than those found in Earth's interior reservoirs [2,3]. Presently known icy satellites and outer solar system objects may have hosted liquid water for significant portions of their histories [4]. The **I**cy **S**atellite **I**nterior **S**imulator (**ISIS**) was constructed to investigate phenomena in such environments. We describe the equipment, principles of operation, and planned future applications of ISIS.

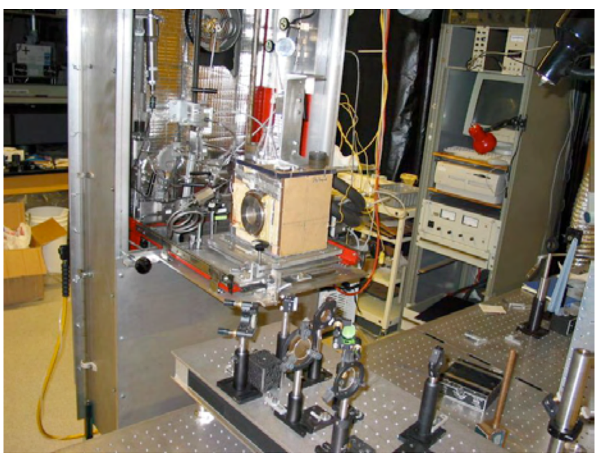

Figure 1. Front view of the icy satellite interior simulator. The cylindrical pressure vessel is shown, contained in an insulating box. In front of ISIS is the setup for impulsive stimulated scattering, which can be used to measure sound velocities and thermal diffusivities [8,9,10].

Equipment: Pressures up to 700 MPa (overlapping the lower range of the diamond anvil cell) are obtained in a 7 mL sample volume using a Harwood model intensifier coupled to a sapphire-windowed Newport Scientific optical absorption cell. An air-driven pump facilitates rapidly changing sample pressure. A separator device isolates corrosive sample materials from ultra-high pressure hydraulic oil (dioctyl sebacate [5]). The separator employs a Brigmann type unsupported area seal in the interior of a piston plug. The o-ring seal used in hydrothermal pressure systems proved unusable due to a glass transition that occurs in available elastomers at around 70 MPa [6]. Aluminum plate and shock-absorbing foam protect the user from noise and shrapnel in case of explosive failure. Sample temperature is set in the range of -30 to 90 ^{o}C with a Lauda circulating heater/chiller.

Pressure is measured with an Omega transducer cross-calibrated to a Heise dial gauge. Both devices are factory calibrated to a NIST certified dead-weight standard. This method assures minimal hysteresis and precision approaching 1 MPa. Sample temperatures are measured with chromel-alumel thermocouple wires calibrated against solid/liquid and liquid/gas phase transitions of water to within 0.1 ^{o}C.

Figure 2. The icy satellite interior simulator, rear view. The Lauda circulating heater/chiller is shown the left. The air-driven hydraulic pump is attached on the right.

Target Applications: The system is presently set up for the method of impulsive stimulated scattering, which permits measurements – in solids [7] or liquids

[8,9] – of velocity to within 0.1%, and thermal diffusivity to within O(1)% [9,10]. Other applications that take advantage of **ISIS**'s optical access include solution phase studies and bacterial microscopy. A conductivity sensor is under development for studies relevant to induced magnetic field measurements in putative icy satellite oceans.

Conclusions: **ISIS** is built to permit a variety of measurements in simulated icy satellite interior environments. Researchers interested in defining new projects for ISIS or coordinating measurements are encouraged to contact the mineral physics laboratory at the University of Washington (contact e-mail above).

References: [1] Vance S. et al (2007) submitted to *Icarus*. [2] Vance S. et al (2006) submitted to *Astrobiology*. [3] Hussmann H. et al (2006) *Icarus*, 185, 258-273. [4] Vance S. and Brown, J.M. (2005) *Icarus*, 177, 506-514. [5] Vergne P. (1990) *High T. – High P.*, 22, 613-621. [6] Paterson M.S. (1964) *J. App. Phys.*, 35, 176-179. [7] Bear B.J. (1999) *J. Chem. Phys.*, 108, 4540-4504. [8] Wiryana S. et al (1998) *EPSL* 163, 123-130. [9] Abramson E.H. (2001), *Int. J. Thermophys.*, 22, 405-414. [10] Abramson E.H. et al (2001) *J. Chem. Phys.* 115, 10461-10463.