PLANETARY SCIENCE ENABLING FACILITY: UNIVERSITY OF TEXAS HIGH-RESOLUTION X-RAY CT FACILITY (UTCT). R.D. Hanna[1], R.A. Ketcham, J.A. Maisano, M.W. Colbert, and D.R. Edey, [1]Jackson School of Geosciences, University of Texas, Austin, TX 78712 romy@jsg.utexas.edu

Introduction: The University of Texas High-Resolution X-ray Computed Tomography Facility (UTCT) is one of 10 inaugural Planetary Science Enabling Facilities (PSEFs). These facilities house combinations of instruments, infrastructure, and technical expertise capable of supporting a broad user base performing research relevant to NASA's Planetary Science Division (PSD). UTCT specializes in X-ray computed tomography (XCT), a 3D analytical technique that is highly beneficial, and in some cases critical, for investigating planetary materials. While the number of labs with XCT scanners is growing, most are lacking either in their instrumentation capabilities (i.e., imaging resolution and energies, sample size range) or in the expertise and support required to extract the highest-quality image data and follow-on analysis. UTCT serves a broad range of scientists worldwide, from academia, industry, and government, working in the earth and planetary sciences and ancillary fields. UTCT also functions as a premier center for technique development and research applications of XCT in the geosciences, including extraterrestrial materials.

What We Do: UTCT has a dedicated staff possessing a combined ~100 years of scientific XCT experience. We not only acquire XCT data for clients, but also assist them in the interpretation and analysis of those data. UTCT develops and distributes several software packages for XCT data processing and analysis [e.g., 1-4] and conducts annual short courses that provide in-depth training on acquisition, visualization, and quantitative analysis of XCT data. These are usually held during the summer at the UTCT facility on the University of Texas at Austin campus. Attendance is free and some travel costs are covered (thanks to partial support from the NSF Earth Sciences Instrumentation and Facilities Program), but the application process is competitive and is usually announced in late spring.

Instruments and Capabilities: UTCT operates two XCT instruments capable of imaging a wide array of sample sizes and types – from submicron imaging of small samples (~mm scale) to lower-resolution imaging of large samples (up to ~75 cm in height and ~45 cm in diameter, depending on sample density).

NSI Scanner. The North Star Imaging (NSI) system houses two X-ray sources: a 450-kV source for large (~dm-scale) or highly attenuating objects, and a 225-kV microfocal source for detailed imaging of smaller samples. This system is also capable of helical scanning of objects with high aspect ratios, such as cores, and 4D scanning to capture system evolution through time (Fig. 1).

Other specialized scanning capabilities of the NSI include: 'MosaiX', which uses separate data acquisitions at different detector positions to create a larger-field virtual detector for objects larger than the detector; and 'SubpiX', which utilizes precise shifting of the detector to double the scan resolution for large objects. The latter was used to image Apollo drive tubes 73001 and 73002 prior to opening [5,6] (Fig. 2).

Zeiss Versa 620 Scanner. The Zeiss Versa 620 source ranges from 30 to 160 kV and up to 25 W with dynamic spot size adjustment down to 0.25 µm. It has a flat panel and 0.4X, 4X, 20X, and 40X detector objectives for imaging objects ~14 cm down to < 1 mm in size, in a configuration that allows for optimized zoom-in imaging of sub-volumes within larger samples. Reconstructed voxel size and feature detectability limits

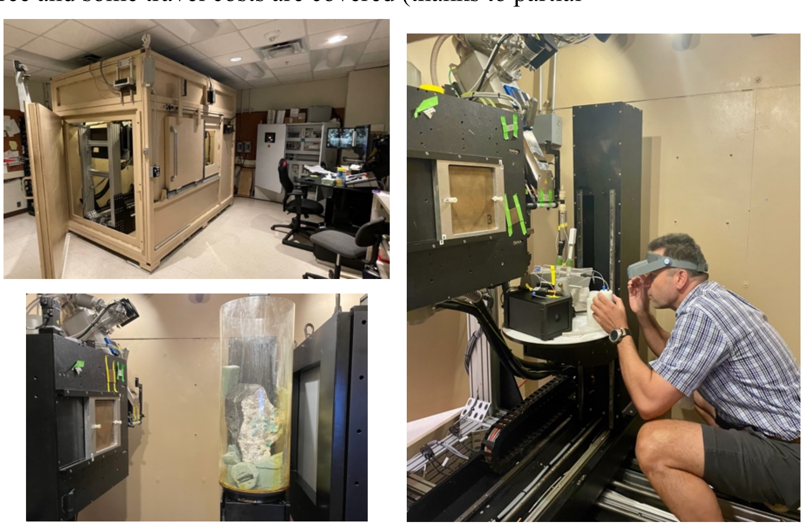

Fig. 1. *(upper left) NSI cabinet with computer controller on right. (lower left) Scan setup of large emerald-bearing rock inside NSI cabinet (450-kV X-ray source on left, flat panel detector on right). (right) Dr. Kuldeep Singh (Kent State University) setting up a flow experiment for 4D scanning of calcite dissolution (using the microfocal 225-kV source).*

vary with sample size but can reach ~0.04 µm and 0.5 µm, respectively.

The Zeiss Versa 620 also has volume stitching capabilities for higher-aspect-ratio samples and automated dual energy scanning to aid in phase discrimination. UTCT has the Deben CT5000-TEC in-situ stage (Fig. 3), which can apply compressional and tensile loads up to 5 kN and includes Peltier heated and cooled jaws with a temperature range from -20°C to 160°C. UTCT's Versa is also equipped with diffraction contrast tomography (DCT) to determine the 3D distribution of crystallographic orientations in sufficiently small samples (currently, < 2 mm) [e.g., 7].

How Much Does Scanning Cost? Rates for scanning and data processing/archiving are currently $125/hr and $96/hr, respectively, for academic and government clients. As a PSEF, UTCT offers a 50% discount to PSD-funded projects. Typical scans for planetary samples run ~$200-400/sample (after discount) but can vary depending on resolution and other data requirements. For grant proposals, UTCT can provide one free test scan as proof-of-principle and help guide PIs in crafting an XCT Data Management Plan.

How To Contact Us: More information is available at http://www.ctlab.geo.utexas.edu/, and potential investigators can contact Dr. Romy Hanna via email (romy@jsg.utexas.edu) to inquire about scanning and to discuss scheduling, feasibility, and cost estimates.

Acknowledgments: UTCT acknowledges support from the NASA PSEF program (award #forthcoming), the NSF EAR Shared Multi-User Facility program (current award EAR-2223808), and the NSF MRI program (award EAR-1919700).

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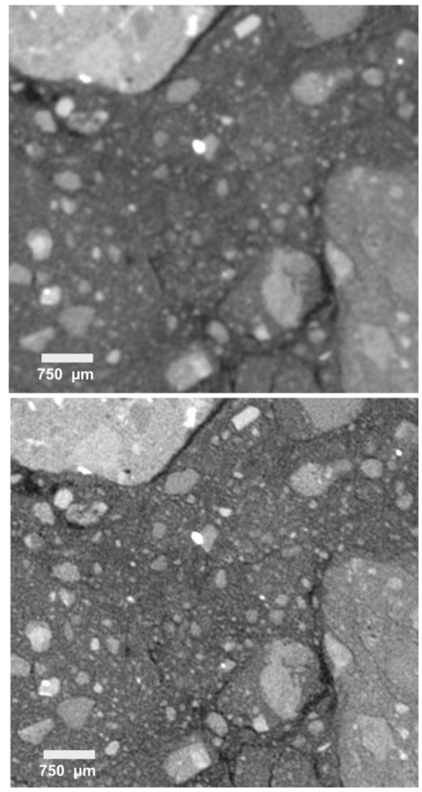

Fig. 2. *One of the 8252 transverse slices comprising the Apollo drive tube 73002 scan illustrating the difference between the "standard" 25.8 µm/voxel scan (top) and the 12.9 µm SubpiX scan (bottom.*

Fig. 3. *(left) Zeiss Versa 620 cabinet and computer controller on left. (right) Deben CT5000-TEC in-situ stage mounted inside Zeiss cabinet for leak testing. Source (with filter wheel) on left and detectors on right.*