Pb-Pb Dating FOR MILLER RANGE 05035, LA PAZ ICEFIELD 02205, AND NORTHWEST AFRICA 032 USING CODEX. F. S. Anderson[1], J. Levine[2], and T. J. Whitaker[1], [1]Department of Space Operations, Southwest Research Institute, Boulder, Colorado 80303, USA (anderson@boulder.swri.edu), [2]Department of Physics and Astronomy, Colgate University, Hamilton, New York 13346, USA.

Introduction: Using an instrument called CODEX (Chemistry, Organics, and Dating Experiment) intended for in-situ dating [1-4], we have obtained Pb-Pb dates for Miller Range (MIL) 05035, La Paz Icefield (LAP) 02205, and Northwest Africa (NWA) 032. For MIL 05035 and LAP 02205, CODEX measurements are consistent and concordant with previous measurements, however, NWA 032 appears unusually old. Proposed explanations for this paradox include: a) terrestrial Pb contamination, b) that there are multiple isotopic reservoirs sampled by the impact process, or c) during volcanic emplacement. Using CODEX, we have previously demonstrated Pb-Pb dates for martian meteorites Zagami and NWA 7034, along with Rb-Sr dates for the Boulder Creek Granite, Zagami [5], and the lunar analog Duluth Gabbro. The Pb-Pb measurements of Zagami and NWA 7034, like previous measurements, also illustrate the Pb paradox. We plan to address the interpretational uncertainty caused by the Pb paradox by adding Uranium measurements to the CODEX capability. In the future, we plan to use CODEX to test these hypotheses by making measurements on outcrops in-situ on the Moon and Mars, avoiding terrestrial or impact mixing, and allowing us to assess age and mantle evolution.

Complementary analyses: In our resonance ionization experiments, atoms ablated from the sample surface by a first laser pulse are excited by subsequent pulses of lasers tuned to electronic transitions in the elements of interest, and are finally ionized from the excited states. Turning the post-ablation lasers off altogether converts our instrument into a laser ablation mass spectrometer, and we have used data collected this mode as an aid in identifying the minerals we analyze [6]. Furthermore, tuning the post-ablation lasers to resonantly excite Pb rather than Rb and Sr allows us to gather geochronological data in the Pb-Pb system, which has the advantage that an age may be determined from isotopes of a single element, so that elemental fractionation in our instrument becomes irrelevant. Adding Uranium will allow us to assess the Pb paradox, and more confidently assess whether Rb-Sr, Pb-Pb, and U-Pb dates are concordant, and allow us to provide assessments of the evolution of multiple isotopic reservoirs.

For many planetary specimens, different isotopic systems yield different age estimates [e.g., 9], and each isotopic system provides necessary clues to help interpret the complex geologic history of the specimen. Discrepancies between very old Pb-Pb ages and very young ages from other radioisotopic systems have been previously observed [e.g., 10], and the proposed interpretations have planetary-scale implications for our understanding of geologic history. With all of its complementary modes of analysis, CODEX can assess the composition, chronology, and concordance of contextualized planetary samples collected in situ.

References: [1] F. S. Anderson et al. *LPSC* 1246, 2 (2017); [2] F. S. Anderson et al. *LPSC* 2957, 2 (2017); [3] S. Beck et al., *LPSC,* 3001, 2 (2017); [4] T. J. Whitaker et al. *LPSC* 2328, 2 (2017); [5] F. S. Anderson et al. *RCMS* 29, 191 (2015); [6] S. Foster et al. *LPSC* 47, 2070 (2016); [7]) from Zhang et al, 2010; [8] Anand et al, 2006; [9] D. Papanastassiou et al., LPSC. (1976), vol. 7, pp. 2035-2054.