A NEW GEOLOGIC MAP OF MONTURAQUI METEORITE IMPACT CRATER, CHILE: IMPLICATIONS FOR SATELLITE-BASED GEOLOGIC MAPPING OF SMALL CRATERS. K. Rathbun[1], I. Ukstins Peate[1], S. Drop[1], and F. Gutierrez[2], [1]Dept. of Earth and Environmental Sciences, 121 Trowbridge Hall, Univ. of Iowa, Iowa City IA 52242 USA, [2]Dept. de Geología, Plaza Ercilla #803, Santiago, Chile (kathryn-rathbun@uiowa.edu)

Introduction: Monturaqui Crater is a small, simple crater (~350 m diameter) located at the southern end of the Salar de Atacama basin in the Atacama Desert of Chile. The crater was formed approximately 663 kya [1] and restructured pre-existing drainage patterns in the area that have subsequently eroded much of the ejecta blanket. The target rock consists of Ordovician granite basement cut by several small (1 – 2 m wide) mafic dikes and overlain by a thin (0 – 5 m), discontinuous layer of Pliocene ignimbrite. The ejecta deposits include ignimbrite, granite, and dark impact melt.

Previous work by Ugalde et al. [2] includes a rough geologic map of the crater based on rock type. A similar map was created in 2008 [3], and a satellite-based geologic map was published in 2015 [4]. However, none of the maps differentiated between target rock and ejecta, and this distinction is important for understanding how the crater has evolved since its emplacement. It can also provide insight into the small-scale processes that occurred during the impact event. One goal of this project is to compare satellite-based mapping with field-based mapping to assess the reliability of satellite-based mapping of ejecta deposits.

Field work: In November and December of 2015, nine days were spent investigating Monturaqui Crater. The investigation included geologic mapping, structural study, assessment of erosion, and collection of ejecta samples for laboratory analysis. The mapping was carried out over a period of three days using colorized 1-m resolution IKONOS images. The new geologic map is more detailed than previous maps and distinguishes the types of ejecta from the target rock. The crater was too eroded to find breccias within the crater wall, but geophysical studies suggest it is underneath the alluvium [2].

The new map [Fig. 1] shows that the distribution of the types of ejecta is more heterogeneous than previously thought [5]. In particular, the site is missing much of the granitic ejecta that would be expected, given that most of the crater wall is granitic, including under the talus and alluvium. Many areas of granitic ejecta are immediately adjacent to areas of mixed ejecta, defined as >25% of one ejecta type within another ejecta type (e.g., 25% granitic ejecta mixed with ignimbrite ejecta). The crater rim has been significantly eroded with ignimbrite cropping out around the entire rim, and this combined with the "missing" granitic ejecta suggests at least 5 m of erosion in the past 663 kyr.

Ejecta in the field is easily distinguished from target rock. Granitic ejecta is located on top of ignimbrite and the ignimbrite ejecta is more "fluffy" with larger block sizes compared to the ignimbrite target rock. In addition, the ignimbrite at Monturaqui shows distinct layering in many outcrops. The ejecta deposits all lie within the continuous ejecta zone

Implications for the reliability of satellite-based mapping of small craters: A comparison of the remote sensing-based map [4] and the new field-based geologic map shows that satellite-based mapping is unreliable at Monturaqui. The bulk compositions of the target rocks are too similar to be adequately distinguished using thermal infrared imagery, which can be used to determine composition (e.g., ASTER TIR). In addition, the resolution of thermal imagery is too large to be useful for mapping the site. However, this approach is still helpful when studying larger craters with more heterogeneous and continuous ejecta deposits; the limiting factor at Monturaqui is its target composition and its size compared to the resolution of thermal imagery. If the target rocks are sufficiently different in either composition or if the melted parts of the ejecta underwent preferential melting of mafic components and was deposited on a felsic target, satellite-based mapping may be able to distinguish between ejecta and target rock.

The amount of erosion at Monturaqui also limits the applicability of satellite-based mapping. The crater is more eroded than it seems in satellite images. In addition, modeling erosion at craters provides limited understanding without a field component [4]. The reliability of satellite-based mapping of ejecta deposits appears to decrease with increasing crater age which corresponds to more erosion of the ejecta blanket.

Conclusions: Remote sensing cannot be reliably used to map ejecta at Monturaqui. Its size, target composition, and amount of erosion all limit the accuracy of mapping and these differences are apparent by comparing field-based maps and satellite-based maps. While there is some overlap, it is clear that satellite-based mapping cannot distinguish between target rock and ejecta at this site. Monturaqui has been studied as a possible terrestrial analog [4] and this issue is poten-

tially problematic if applied to the mapping of small craters on Mars as well.

References and Acknowledgements: [1] Ukstins Peate I. et al. (2010) *LPSC 2010*, Abstract #2161. [2] Ugalde H. et al. (2007) *Meteoritics & Planet. Sci., 42*, 2153-2163. [3] Cukierski D. (2013) Textural and compositional analysis of Fe-Ni metallic spherules in impact melt from Monturaqui Crater, Chile. M.S. thesis, Univ. of Iowa, 135 pp. [4] Rathbun K. and Ukstins Peate I. (2015) *LPSC 2015*, Abstract #2778. [5] Ukstins Peate I. (2014) pers. comm.

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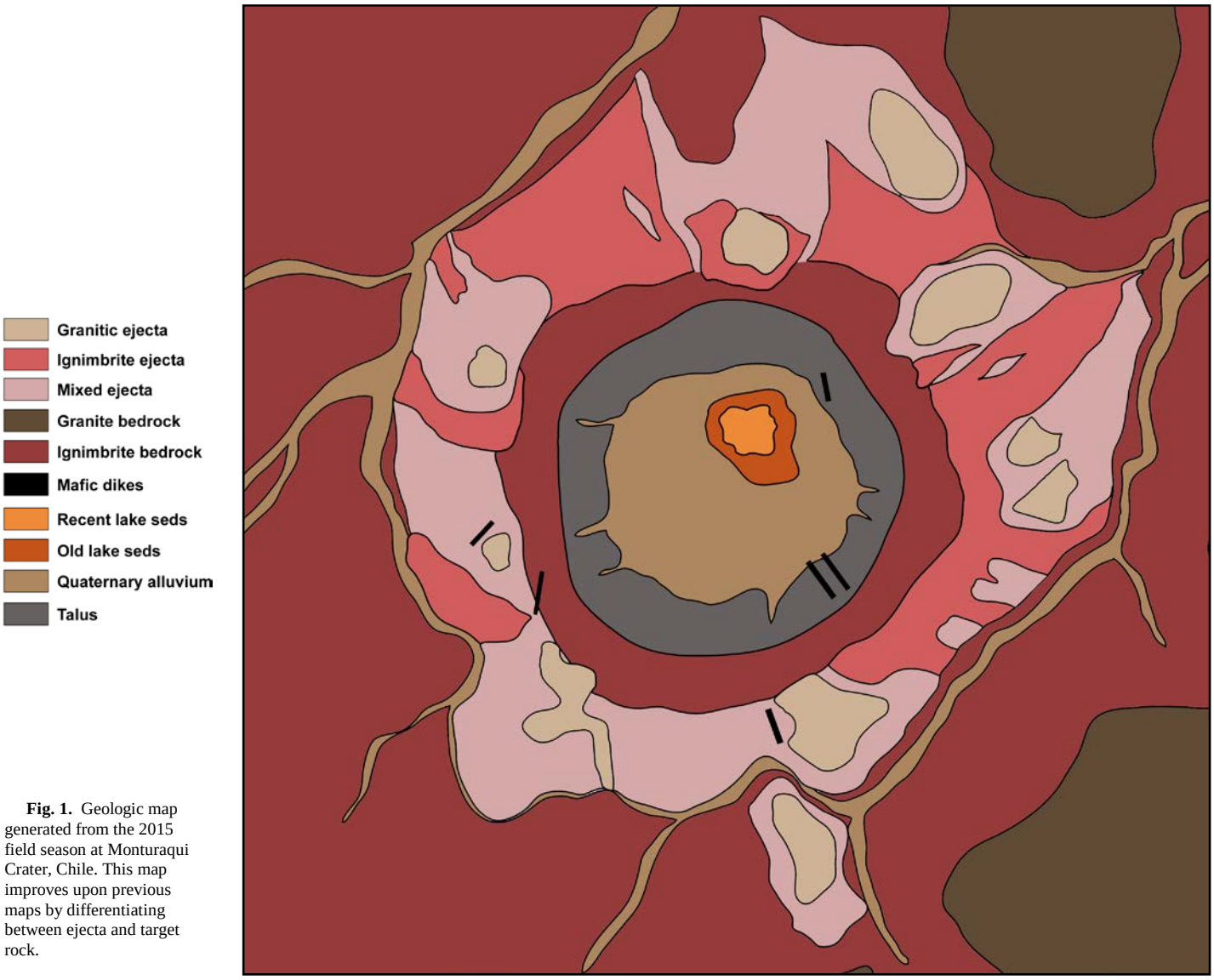

Fig. 1. Geologic map generated from the 2015 field season at Monturaqui Crater, Chile. This map improves upon previous maps by differentiating between ejecta and target rock.