GEOLOGIC MAPPING OF THE ZAL REGION OF IO. M. K. Bunte, D. A. Williams, and R. Greeley. School of Earth and Space Exploration, Arizona State University, Box 871404, Tempe, Arizona 85287, (Melissa.Bunte@asu.edu).

Introduction: We have produced a regional geologic map of the Zal region of Io's antijovian hemisphere based on a *Galileo* Solid State Imager (SSI) regional mosaic (335 m/pixel) and a color mosaic (1.4 km/pixel). Here we discuss the geologic features, summarize the map units and structures that are present, discuss the nature of volcanic activity, and give conclusions about volcanic, tectonic, and gradational processes to understand Io's geologic evolution.

Zal Region: The Zal region (25-45˚N, 65-85˚W) is in Io's leading antijovian hemisphere and consists of Zal Patera (120 km wide x 197 km long), two major mountains (north and south Zal Mons) which border Zal Patera to the west and south [1], and Rustam Patera (proposed name) west of south Zal Mons. The Zal region includes at least two hotspots detected by *Galileo*: one along the western scarp of the Zal Patera volcano and one at the Rustam Patera volcano. The floor of Zal Patera has been partly resurfaced by dark lava flows since *Voyager* imaging; portions of the patera floor appear unchanged during the *Galileo* mission. Mountains exhibit stages of degradation. The western bounding scarp of Zal Patera appears to be a fissure source vent for multiple silicate lava flows. The Zal Montes and Patera complex appears to be an example of volcano-tectonic interactions [1, 2]. Several of the flow units emanate from the fissure at the western scarp [2].

Map Units: Material units and structural features in the Zal region (**Fig. 1**) are consistent with SSI-and *Voyager*-based maps of other regions [3, 4, 5, 6, 7, 8]. We have identified 19 units derived from five types of materials: plains, mountains, patera floors, flows, and diffuse deposits. *Plains* are thought to consist of silicate crust mantled by dark silicate and bright sulfurous explosive and effusive deposits [9, 10]. The plains are formed by combinations of over-lapping effusive flows, mass wasting of flow materials, SO_2 sapping scarps and pits, deposits from volcanic plumes containing SO_2 and sulfur frosts, and pyroclastic flows [11, 12, 13]. Based on color, we subdivide the plains into yellow (sulfur-dominated), white (SO_2-dominated), and red-brown (radiation-altered) subunits. *Mountain* materials are often visible only in low-sun images where shadows highlight scarps, ridges, grooves, and mountain peaks [2, 13, 14]. We characterize three types of mountain materials: lineated (containing well-defined ridges and grooves, interpreted to be tectonically-uplifted crustal blocks), mottled (containing lobes and hills, interpreted to be materials displaced by mass movement that is likely the result of SO_2 sapping [2, 12]), and undivided (mountain material that is characterized by aspects of both the mottled and lineated units, but is dominated by neither). Plateaus can exhibit characteristics of any type of mountain materials. *Patera floor materials* are compositionally similar to flow materials but are emplaced within the bounding scarps of paterae. We characterize two subunits: bright and dark (sulfuric and silicate lavas coated by sulfurous deposits; e.g., [3, 4, 15]). *Flow* materials are typified by their generally linear morphology (lengths >> widths) and sharp contacts [3, 4, 5, 6]. Like patera floors, lava flow materials are characterized using morphology, color and albedo as bright (sulfur-dominated) or dark (silicate-dominated and associated with active hotspots [15, 16, 17]). Albedo variations in the dark flows are thought to indicate surface exposure: the freshest flows are generally darkest. Color tint of flows is due to mantling by diffuse material. Flows with intermediate albedos and ill-defined contacts make up undivided flow materials. *Diffuse deposits* thinly mantle underlying topography and typically occur near active volcanoes. Colors are interpreted to be indicative of the dominant chemical constituent: sulfur, sulfur dioxide, silicate, either short-chain sulfur and/or sulfur chlorides, and products of silicate-sulfur alteration, respectively [18, 19]. White, bright, and red diffuse deposits are present.

Structural Features: The Zal region contains a variety of structural features, including scarps, ridges, grooves, pits, graben, and lineaments. Scarps delineate both mountains and plains. Most grooves, lineaments, and ridges are found in the mountain units. The plains contain several scarps and depressions indicative of tectonic activity. None of these features are found within the flow fields. No positive relief volcanic constructs such as domes, cones, or shields are resolvable. As in all previous Io images, no impact craters were detected, supporting the contention that the surface of Io is perhaps only a few million to a few tens of millions of years old [20].

Discussion: Our mapping provides insight into the geologic processes that are active in this region of Io. The Zal region exhibits various forms of volcanic activity, including Promethean style flows emanating from Rustam Patera and a fissure vent at the western bounding scarp of Zal Patera. Both silicate and sulfur-rich lava flows are present; individual flows appear to be of different ages, i.e., in different stages of alteration inferred from their differing albedo and color. Zal Patera is an active compound flow field but is not a flooding lava lake. The detection of a plume by LORRI on *New Horizons* [21, 22] confirms that Zal is currently active, producing small-scale Pele-type plumes. The mountain units appear to be tectonically related by rifting, although they each exhibit different degradation features suggestive of SO_2 sapping and mass wasting. Morphologies and cross-cutting relationships of several flows in the region suggest that north Zal Mons was uplifted and modified. It is unclear whether the patera formation has separated the mountain units. We speculate that the level of degradation of each of the mountain and plateau units is influenced greatly by the proximity to active vents.

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Figure 1: *Preliminary geologic map of the Zal region of Io's antijovian hemisphere. The base map is the Galileo SSI observation I27ZALTRM01 (335 m/pixel).*