SUBICE VOLCANISM ON THE AZAS PLATEAU: A COMPARISON WITH POSSIBLE MARTIAN TUYAS. G. Komatsu[1] and Y. Litasov[2], [1]International Research School of Planetary Sciences, Universita' d'Annunzio, Viale Pindaro 42, 65127 Pescara, Italy, goro@irsps.unich.it, [2]Institute of Geology, Russian Academy of Sciences, Siberian Branch, Koptyug Ave. 3, Novosibirsk, 630090 Russia, yuryl@uiggm.nsc.ru

Introduction: Internal layered deposits (ILDs) in Valles Marineris are characterized by their extensive thin layering and their unique relationships with the canyons. The subice volcanism hypothesis [1, 2] has a strong possibility to explain the geometry of at least some of the ILDs as well as other suspected volcanic features in Valles Marineris. Subice eruptions of lavas melt the ice above and often form edifices called tuya within the meltwater englacial lakes. A typical tuya is characterized by pillow lavas overlain by a thick hyaloclastite unit. The hyaloclastites are capped by armoring near-horizontal lava layers. Slope failures can occur and the cap lava layers may drape the edifice (inclined lava layers or foreset beds), forming lava deltas. At least some ILDs exhibit features resembling these components of tuyas [2].

Tuyas on the Azas Plateau: For comparisons, we examined the tuya edifices in the Tuva volcanic province located on the Azas Plateau in the Tuva Republic of the Russian Federation (Figures 1, 2 and 3). The province is the westernmost lava field of the Baikal Rift System. The tuya edifices are Pleistocene in age and their formation coincides with extensive glaciation in the region. The compositions of the volcanics are alkaline basalts and basanites [3]. They have typical tuya characteristics with more than several hundreds meters thick hyaloclastites and armoring up to over one hundred meters thick massive lava flows (Figure 3) but the hyaloclastite-lava flow sequence could repeat within single edifices [3].

Comparison with Martian ILDs: Some ILDs in Valles Marineris (Figure 4) have a striking resemblance to the tuyas in terms of overall geomorphology. Note the semi-flat cap units, steep gullied sidewalls, and parts of edifices extended like wings to various directions. Dike and volcanic neck-like landforms observed, for example, in the Gangis ILD [4] may be consistent with feeding dikes/necks occurring in tuyas [3]. In the case of terrestrial tuyas, subaerially erupted lavas may flow into water forming lava deltas. Lava deltas could have a structure of bottomset, foreset, and topset beds. An example of inclined beds analogous to draping lava layers may exist with the Gangis ILD (Figure 4). Hyaloclastites are produced by essentially non-explosive processes related to rapid cooling and fragmentation of lava erupted in water [5] and they may be massive and uniform or stratified [2]. The hyaloclastites may have characteristics similar to the features observed in the main facies of the ILDs. An example is shown in Figure 3. However, in reality the majority of tuya hyaloclastites do not appear to develop such extensive layering as we observe with the Martian ILDs. So this point may require explanations if the subice volcanism hypothesis is valid. One possibility is that the thin layers in the ILDs are not hyaloclastites, but instead they are tephra deposits [6] produced with more explosive eruption stages and accumulated within the meltwater lakes encompassed by ices thus still explaining the confined geometry of the ILDs such as the ones in Hebes and Gangis. Volcanic fall out deposits such as tephra are more likely to develop extensive regularly stacked sequences and the tephra associated with subice volcanism can form thick unbroken sequences individually a few to tens of meters thick [6]. The subice volcanism hypothesis is also consistent with the preservation of underlying topography such as the canyon walls and chaotic terrain [7] because of rapid deposition with respect to mass-wasting processes.

Tuyas of the sizes equivalent to the ILDs are not known on Earth. However, volcanism on Mars may exceed the scale limit on Earth. Whether this hypothesis is valid for all the deposits or only some of the ILDs remain to be studied.

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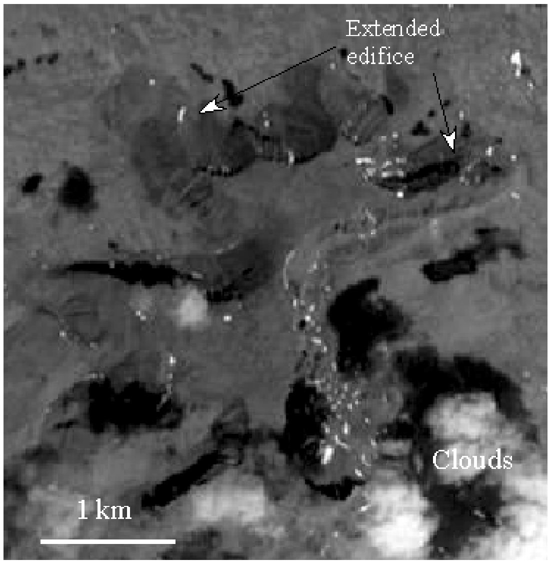

Figure 1. The Derbi-Taiga Volcano on the Azas Plateau. This tuya volcano is characterized by flat-topped cap rocks and a gullied thick hyaloclastitic sequence. ASTER image.

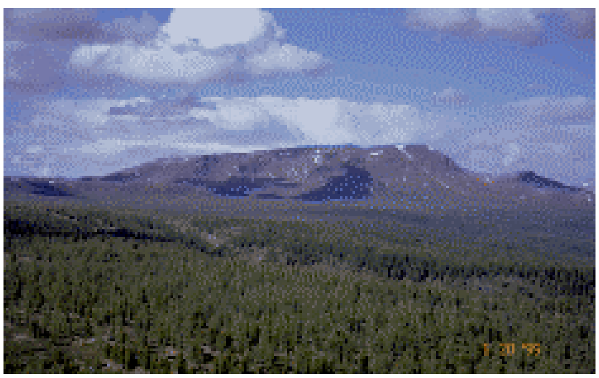

Figure 2. Side view of Derbi-Taiga.

Figure 3. Oblique layering of lower hyaloclastitic units and near-horizontal layering of upper armoring lava flows. The Kok-Hemskii Volcano.

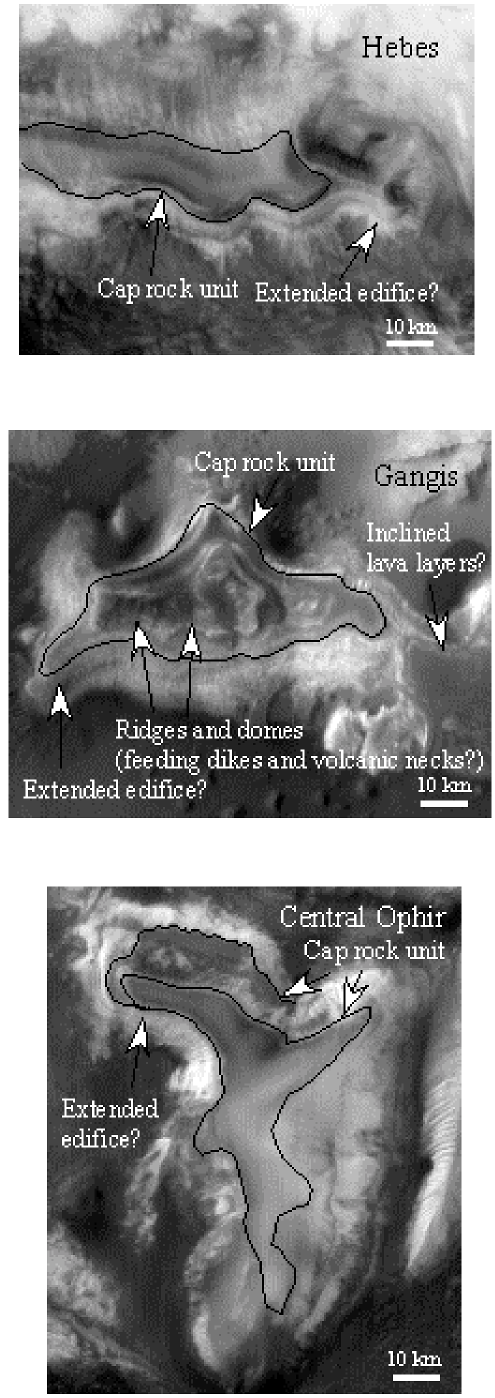

Figure 4. Examples of ILDs that resemble tuyas in their over all morphology including relatively flat cap units, steep sides with gullies, and extensions of edifices like wings. In the Gangis ILD, possible feeding dikes, volcanic necks and inclined lava layers are also observed. The scales of these ILDs are an order of magnitude greater than the terrestrial tuyas. MOC images, Hebes (M0906483), Gangis (M0400324), and Central Ophir (M1801894).