The style and characteristics of young magmatism on Mars

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On Mars, very young magmatic activity has been identified in several places such as Central Elysium Planitia (CEP, Keszthelyi et al., 2010, Jaeger et al., 2010) and Amazonis Planitia (AP, Hartmann, 2003, Harman et al., 2012). The existence of such young activity places a strong constraint on the thermal structure of the present Mars as well as its thermal evolution. A key question arises as for this; whether the young magmatism is different from those lasting for long period in the Martian history, which are characterized as huge-edifice building magmatism such as the formation of Olympus Mons. Both CEP and AP are well known to have very smooth surface characteristics (Kreslavsky & Head, 2000, Aharonson et al., 2001), which is interpreted as a result of flooding of low-viscosity lava. The landscape seems quite different between young ones and long-lasting ones. Is this also true for the magmatic activity?; this question is a starting point of our investigation. To answer this, we have conducted geomorphological surveys at CEP and AP to characterize young volcanism.

In this study, we have picked up these two regions as the survey area to conduct comparative investigations on the morphology. In both areas the smooth plains are interpreted as lava flows mostly because of the existence of small cones, which are identified as rootless cones caused by magma-water interaction. Particularly in CEP, Noguchi & Kurita, 2012 reported existence of peculiar cone morphology (Double Cone Structure, DCS), which strongly indicates of the magmatic origin. Since the smooth lava plains are featureless, existence of cones should be an unique criterion for the magmatic identification. In CEP, flooding lava emanated from Cerberus Fossae (Plescia 2003) and flowed into Athabasca Valles. On the other hand, in AP the extent of lava flow units are not precisely determined and the source regions are not specified. Fuller and Head, 2002 showed that southern AP lava was derived from Tharsis Montes. By contrast, Harmon et al., 2012 suggested that Southern AP (SAP) lava has the local source, and Northern AP (NAP) lava flow was derived via Marte Valles, west of AP. We conducted mapping of lava flow units in AP to constrain the extent and the source regions by focussing two morphological features in CTX and HiRISE images: 1) decelerating ridges whose strikes are perpendicular to the flow direction, and 2) linear alignment of cones which are parallel to the flow direction.

As a result, we found most of AP cones locate in SAP, and few cones exist in NAP. There are 2 cone regions in SAP, eastern area and western area. Diameter of cones in western area of SAP is larger than those of eastern area. The direction of linear alignment of cones in SAP is different between eastern area and western area. This difference suggests that there are 2 lava sources in SAP, and shows that magmatism in AP is more complicated than CEP.