N92-10791

RHEOLOGICAL ANALYSES OF LAVA FLOWS ON MARS; H.J. Moore, U.S. Geological Survey, Menlo Park, CA, 94025 and P.A. Davis, U.S. Geological Survey, Flagstaff, AZ, 86004.

We have obtained some 183 profiles of lava flows on Mars using photoclinometry [1]. These photoclinometric profiles were leveled by adjusting them until the levee crests or bases had the same elevations (depending on the situation). Here, we report some of the results of our analyses of twenty-seven flows on the flanks of Alba Patera (3 flows), near the summit of Ascraeus Mons (6 flows), the flanks of Arsia Mons (3 flows), and the flanks of Olympus Mons (15 flows).

In our rheological analyses, we use a wide-flow model [2], Hulme's model [3], and model 1 of Baloga and Crisp [4]. Effusion rates are estimated by using an unmixed-cooling model [5] that is calibrated by using Hawaiian flows [6] and a Graetz-number model [4,7]. Our Graetz-number effusion rates vary from about 0.4 to 1.2 times those of the unmixed-cooling model; a mixed-cooling model [5] yields effusion rates that are 20 times larger than the unmixed-cooling model.

The models have been applied to terrestrial flows that range from basalts to rhyolites (Fig. 1A) [6].

Despite the use of different models by different workers [8,9,10,11], the results are similar in that the range of values are quite large, especially for the Bingham viscosities (Fig. 1B). Our average yield strengths for each flow range from about 1 to 20 kPa and average Bingham viscosities for each flow range from about 0.02 to 8 MPa*s. Our results are compared with those of others [9,10,11] in Table 1.

Although estimates using our empirical procedures are subject to many uncertainties, the results in Figures 1A and 1B suggest to us that the flows examined to date are not felsic or ultramafic; rather, they probably range from basalts to basaltic andesites. The same general conclusion is reached when the same model set is applied separately to the data sets. Thus, the suggestion that flows on Olympus Mons [8], and elsewhere [6,9,10], may be more silicic than Hawaiian basalts is supported by our results. These suggestions are testable with suitable measurements of silica contents of the flows.

Table 1. Comparison between our yields strengths and Bingham viscosities and those listed under reference (in parentheses) for three martian volcanoes.

Volcano	Yield Strength (kPa)	Bingham Viscosity (Pa*s)	Reference
Ascraeus Mons	5-9 (10-40)	0.05-6 (1-100)	[9]
Olympus Mons	1-20 (2-40)	0.02-8 (0.7-20)	[10]
Alba Patera	2-6 (8-28)	0.09-0.9 (0.1-2)	[11]

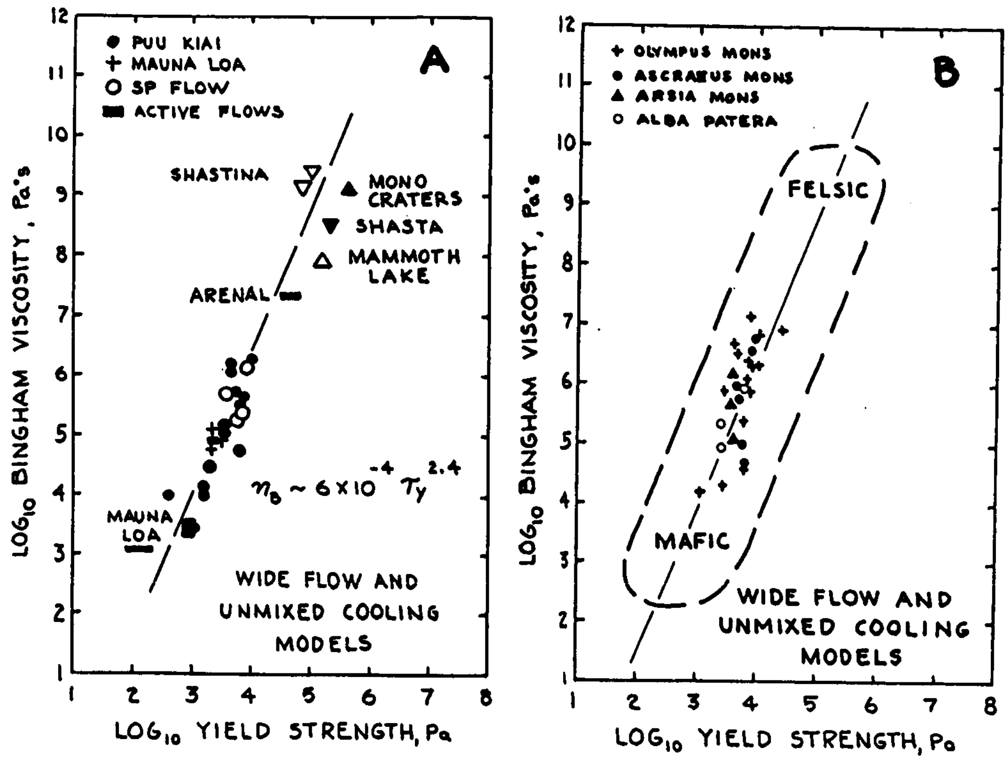

Figure 1. Bingham viscosity versus yield strength. A. Terrestrial flows with compositions that range from basalt to rhyolite [6]. B. Average values for martian flows and composition fields from A.

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