LANDSLIDE MOTION: NUMERICAL SIMULATION FOR EARTH AND MARS; A.V.Potapov and B.A.Ivanov, O.Yu.Schmidt Institute of Physics of Earth, USSR Acad. Sci., Moscow, USSR, 123810.

The presence of a great amount of large landslides (V > 1E7 m3) on the martian surface [7] put forward a question how to compare these features with terrestrial analogs [8]. One of the obstacles in this way is a poor knowledge of the mechanics of large landslides motion which demonstrates the anomalously low internal friction. The aim of this work is to simulate numerically the motion of avalanches of large volume using the viscous fluid-like model.

The fluid-like behavior of avalanches was considered elsewhere (see for example [2, 3]). Modern theories insist on the existence of a layer of small viscosity near the bottom of the large rockslide [1, 4]. To simulate the runout of large avalanches we use the SMAC method [5, 6]. We use power-low shear stress-strain rate dependence :

$$\tau = A \rho \dot{\varepsilon}^{\alpha}$$

where τ is shear stress, ρ is density and $\dot{\varepsilon}$ is shear strain rate. This law has been chosen partially due to the impossibility of using the same two-viscous model parameters [5] for different avalanches and partially due to the results of the Melosh theory [1].

We investigated numerically three avalanches: Madison Canyon (V=2E7m3), Usoy (V=2E9 m3) and artificial avalanche on the territory of the USSR (V=8E7 m3). We obtained A=144 and α=0.28 (all units are in the SI dimensions). Because of the impossibility of using the SMAC method with infinite viscosity near zero shear strain rate we "cut" the power law by the straight line $\tau/\rho\dot{\varepsilon}$ = 300 m^2/s (Fig. 1). The avalanche is believed to stop when $\dot{\varepsilon}<0.37\ s^{-1}$ in all parts of the avalanche body. Fig. 2 shows the pre- and post-slide Usoy profile (dotted for the simulated profile and solid for the observed one).

For all three considered avalanches the discrepancy between the observed and simulated profiles is small. Part of the difference can be ascribed to the lateral spreading of the avalanches which is not simulated by our two-dimensional model.

We used the same τ-$\dot{\varepsilon}$ relationship to simulate the Martian landslides of large volume. Unfortunately we have no real pre-slide Martian slope profiles. So we had chosen the typical slope profile and calculated the avalanche runout for martian and terrestrial gravity (Fig. 3). The adopted shear stress-strain rate dependence demonstrates the difference between the Earth and Mars landslides : less runout and larger thickness of the martian landslides for the given landslide volume. The obtained results of numerical simulation may be used in geological interpretation of martian rockslides.

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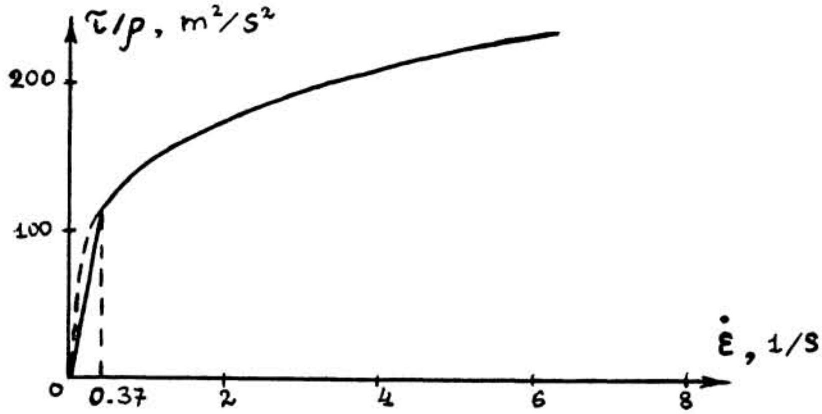

Fig. 1

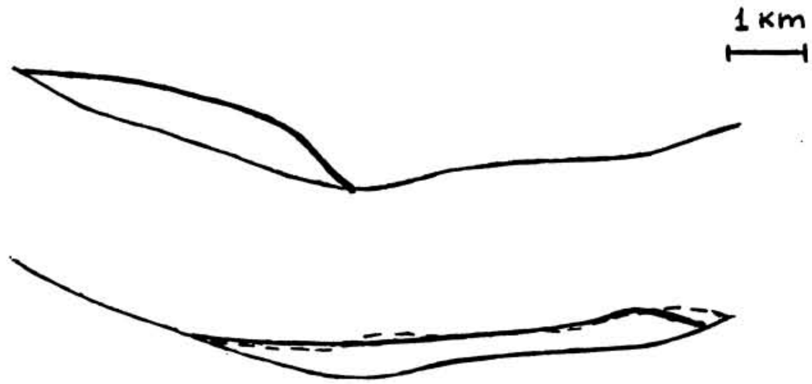

Fig.2.

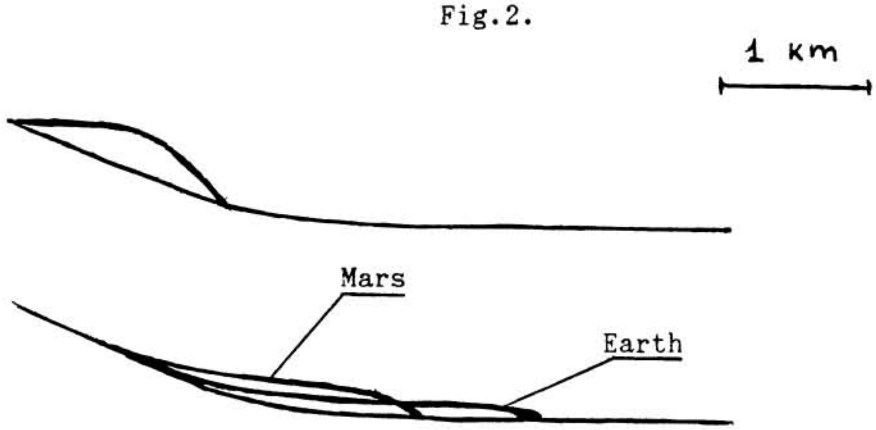

Fig.3