K-AR DATING ON MARS?

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Dating rocks on Mars is a major challenge and would be a fundamental progress in the knowledge of its formation and evolution, with implications for primitive Earth knowledge.

It can be done using potassium-argon method. Potassium is universally distributed and one of the major constituents of silicates. Considering an order of magnitude of Gyears for the age of rocks at the surface of Mars, the natural decay from ^{40}K has accumulated a large amount of radiogenic ^{40}Ar; it can be easily measured after extraction from a minute volume of the mineral. On Earth, the radiogenic argon percentage in potassic minerals over 1 Gyear reaches more than 99.9% which makes not necessary an accurate correction for the atmospheric contamination based on the measurement of a non radiogenic argon isotope (^{36}Ar). Such contamination is even more negligible for the martian rocks owing to the reduce atmosphere.

Dating terrestrial magmatic and plutonic rocks is now generally performed by the argon-argon technique, based on the same potassium-argon chronometer. This technique compares the 40/39 isotopic ratios of argon extracted from the sample to the one of a standard mineral in which 39 potassium has been activated into 39 argon by neutron irradiation under the same conditions as the sample to be dated. The technique is powerful as 1) it works on isotopic ratios unavailing any quantification of the mineral amount used and also its total extraction, 2) it makes it possible to date single grains, 3) even if the analytical conditions vary in the mass spectrometer, the measured isotopic ratios remain constant, 4) it permits to identify, from a stepwise heating, any thermal effect having affected the rock.

But *in situ* dating on Mars is unrealistic using argon-argon technique as it needs the same neutron irradiation on sample and reference mineral. These conditions prohibit the application of the $^{40}Ar/^{36}Ar$ technique for such study.

Considering that the rocks at the surface of Mars were not affected by significant thermal crisis (>400°C for the concerned silicates), argon-argon dating technique appears not *sine qua non*, which is also true for the majority of the rocks at the Earth surface: granites from Precambrian cratons of Africa are accurately dated by potassium-argon conventional technique, in fairly good agreement with U-Pb dating.

We develop an analytical system operating the potassium-argon dating.^{40}Ar is measured after purification of active gases from the amount extracted, under vacuum, from a sample rock mineral, by laser ablation. We have demonstrated (Rouchon et al, 2008, Int. Journ. Mas Spectro. 270:52-61) that accurate argon dating was achievable from quadripolar mass spectrometric measurements. The K abundance is determined *in situ* by spectral emission spectroscopy from the plasma generated by the same laser ablation. The realization of the potassium-argon dating needs only to determine the mineral amount from which argon was extracted. The analyze of the argon extracted from minerals of known age makes possible to quantify it. We thus calibrate the laser impact on pure minerals with a reproducibility better than 10 %.

It permits to insure the feasibility of K-Ar dating on Mars, by calibrating the argon extraction from silicates and thus quantify the argon and potassium measurements achieved *in situ* on Mars.