Europa's subsurface ocean

N. Schilling[1], F.M. Neubauer[2] and J. Saur[3]

[1]Institut für Geophysik und Meteorologie, Universität zu Köln, Cologne, Germany (schilli@geo.uni-koeln.de)
[2]Institut für Geophysik und Meteorologie, Universität zu Köln, Cologne, Germany (saur@geo.uni-koeln.de)
[3]Institut für Geophysik und Meteorologie, Universität zu Köln, Cologne, Germany (neubauer@geo.uni-koeln.de)

Recent geological and geophysical observations from the Galileo spacecraft indicate that Europa, one of the icy moons of Jupiter, harbors a salty ocean of liquid water beneath its icy surface. Magnetic field perturbations observed by the Galileo spacecraft at Europa, are consistent with induced magnetic fields from the interior of the moon. These magnetic fields are very likely caused by electromagnetic induction in a subsurface water ocean with high electrolytical conductivity. An additional process, which also generates magnetic field perturbations at Europa and therefore competes with induction, is the interaction of Europa's oxygen atmosphere with the magnetospheric plasma in which the moon is embedded. We have developed a time dependent 3D model to study simultaneously the electrical conductivity distribution inside Europa and the time-varying interaction of Jupiter's magnetosphere with Europa's atmosphere. By comparing our simulation results to the Galileo spacecraft measurements by Europa, we place the so far strongest constraints on the conductivity and the thickness of Europa's subsurface ocean. We find an internal ocean close to the surface with a conductance of 50,000 S or larger to be most suitable to explain the magnetic flyby data. These results suggest that a global subsurface ocean at Europa with terrestrial "sea water" would have to be thicker than 10 km.

In situ cosmogenic ^{36}Cl production rate calibration on basaltic flows of Mount Etna (Sicily, 38°N)

I. Schimmelpfennig[1], L. Benedetti[1], R. Pik[2], P. Burnard[2], P.H. Blard[3] and D. Bourlès[1]

[1]CEREGE, UMR 6635 CNRS, Aix en Provence, France (schimmel@cerege.fr)
[2]CRPG, UPR 2300 CNRS, Vandoeuvre-lès-Nancy, France
[3]CALTECH, Pasadena, CA 91125, USA

One of the CRONUS-EU goals is to provide high quality calibration sites from independently dated surfaces. Several previous studies have been conducted on ^{36}Cl production rate calibration (e.g. Stone *et al*. 1996, Phillips *et al*. 2001), which, however, used different protocols and yielded ^{36}Cl production rates with up to 40% discrepancies. The objectives of this study are 1- to understand the source of these discrepancies and 2- to calibrate ^{36}Cl production rates from its most abundant target elements ^{40}Ca, ^{39}K and ^{35}Cl.

As a first step we focused on testing the chemical protocol by performing a sequential ^{36}Cl extraction experiment on whole rock grains and Ca rich plagioclase from the same sample. The sample was collected at Mt. Etna on a pahoehoe flow which has a K-Ar fossil exposure time of 10±3 kyr. Cosmogenic ^{3}He of this sample was also precisely measured within cogenetic olivine phenocrysts (Blard *et al*. 2005) and yields an exposure time of 10.4±1.5 kyr.

Both, total Cl and ^{36}Cl concentrations from the first dissolution steps are high, 5800 ppm (whole rock) and 450 ppm (plagioclase) Cl, and 10^7 - 10^6 atoms ^{36}Cl/g of rock dissolved. After about 20% dissolution of the plagioclase sample, Cl is almost completely removed (1-3ppm) and ^{36}Cl concentrations reach a plateau value of $2*10^5$ atoms/g of rock. Using the Stone *et al*. (1996) and Evans *et al*. (1997) ^{36}Cl production rates for the target elements Ca and K, respectively, this plateau concentration yields an exposure age which is in agreement, within uncertainty, both with K-Ar dating and cosmogenic ^{3}He ages. On the contrary, in the whole rock sample total Cl concentrations remain high (>330ppm) resulting in a considerable ^{36}Cl production from capture of low-energy neutrons by ^{35}Cl, an additional and still not well-constrained ^{36}Cl production mechanism. The resulting exposure ages from the whole rock are 20-30% higher than the independent ^{3}He ages.

To better constrain the different sources of ^{36}Cl in basaltic rocks and their production rates we will perform a similar experiment on separated sanidine (K-rich feldspar) from an independently dated basaltic flow of another volcano.

References

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