**MARS ODYSSEY GRS RESULTS AT THE CERBERUS PLAINS.** B. Diez[1], S. Maurice[1], O. Gasnault[1], L. d'Uston[1], W. C. Feldman[2], D. Baratoux[3], N. Mangold[4],. [1]CESR, Université Paul Sabatier, CNRS, Toulouse, France (benedicte.diez@cesr.fr). [2]PSI, Tucson, AZ. [3]LDTP, Observatoire Midi-Pyrénées, Université Paul Sabatier, CNRS, Toulouse, France. [4]IDES, Université Paris Sud, CNRS, Orsay, France.

**Introduction:** The Cerberus plains were suggested very early to have a volcanic origin [1]. However the smoothness of the region has triggered questioning. Hypotheses involving aeolian processes or sedimentary deposits through fluvial events [2] have been examined. Crater counts have revealed the region to be very young [3].

We analyze the neutron signals measured by the Neutron Spectrometer (GRS NS) on board the Mars Odyssey satellite at the Cerberus Plains. The neutron currents are correlated to the local geology in all three energy ranges: thermal, epithermal and fast neutron. We infer the geochemical constraints derived from this correlation via the use of the macroscopic absorption cross section. This variable measures the ability of a material to absorb neutron, and therefore gives clues of its chemical composition.

We confront the neutron derived chemical constraints to the elemental abundances measured by the Gamma Subsystem (GRS GS), also on board Mars Odyssey. They reveal different information, which is interpreted to be due to the difference of probed objects. We use the knowledge already derived from other experiments and a detailed examination of the GRS datasets to determine a general scheme of the geology of the region and possible mechanisms of emplacement.

**Neutron Spectrometer signals:** The neutron signals estimated by the Mars Odyssey Neutron Spectrometer do not correlate particularly well with the geological maps except in the Cerberus plains. A recent volcanic unit within this region corresponds to a local maximum of neutron emission in all three ranges of energy: thermal, epithermal and fast.

We model the geomorphic configuration by attributing hypothetic neutron emission intensity to geologic units. We infer the post Marte Valles lavas [4, 5] to emit a high epithermal neutron signal (arbitrary set at the counting rate 12) and the rest of the region a low epithermal neutron signal (arbitrary set at the counting rate 5). We convolve this model by the spatial response function of the neutron spectrometer (a two-dimensional Gaussian having 10° FWHM).

Figure 1 shows the results after convolution by the response function of our instrument superposed on the measured epithermal neutron currents. The model gives an excellent fit of the real signal.

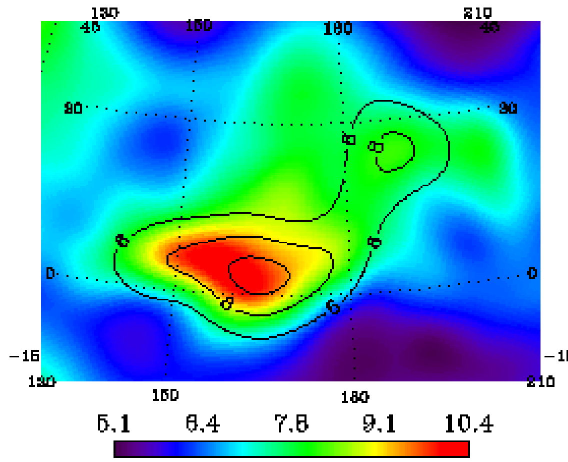


**Figure 1.** Cylindrical projection of the epithermal neutron currents (in cts/s) measured by GRS NS smoothed by a 2deg FWHM Gaussian function. Superimposed are contours of the epithermal neutron currents simulated with the assumption that fresh lavas emit a stronger neutron signal than the rest of the region.

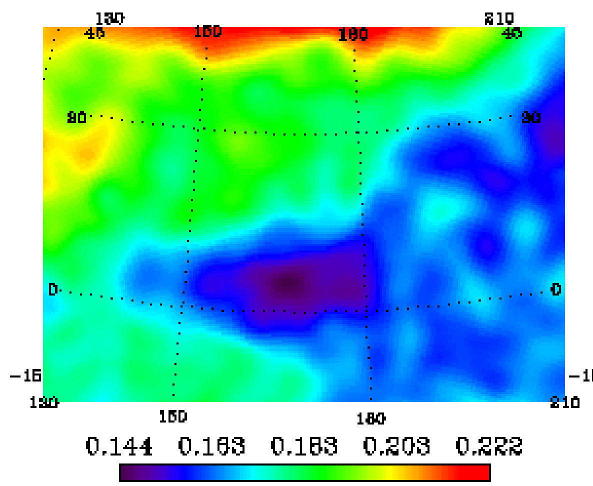


**Figure 2. C**ylindrical projection of the ratio of fast over thermal neutron currents measured by GRS NS smoothed by a 2deg FWHM Gaussian function.

Practically, having a strong fast neutron signal means that the material is rich in neutron producers (for instance Fe and Ti). Having a high thermal neutron signal means that the material is deprived from strong neutron absorbers (for instance Cl or Mn). Although it is impossible to directly infer the concentration in the individual elements with the neutron currents only, the measured ratio provide constraints on the chemical composition of the near-surface material. The ratio of fast to thermal neutron currents is correlated to the macroscopic absorption cross section for unlayered material [6]. The region of the Cerberus plains exhibits a very low fast to thermal neutron currents ratio (figure 2) signifying a low macroscopic absorption cross section.

**Gamma Subsystem signals:** The Gamma Subsystem provides a direct measure of the abundances of Cl, Fe, Si, K, H and Th under the assumption that the composition is constant with depth [7]. We estimate the macroscopic absorption cross section of the Martian superficial material that is consistent with these abundances. The macroscopic absorption cross section estimated with the Gamma Subsystem is not correlated to the same geomorphic unit than the Neutron Spectrometer.

The Cerberus plains have a high abundance of chlorine. However, because of the large response function of the instrument, the signal at Cerberus can either result from the contamination by the neighboring Cl-rich region Medusae Fossae or from the actual composition at Cerberus. Consequently to the high absorption ability of chlorine, the GRS GS data predict a high absorption cross section at Cerberus (figure 3).

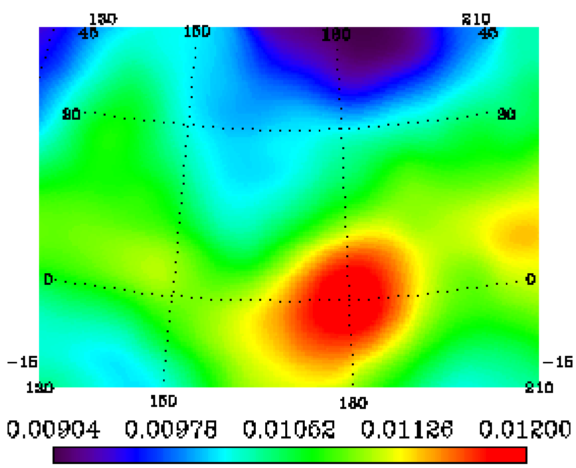


**Figure 3. C**ylindrical projection of absorption macroscopic cross section in $cm^2$ calculated on the basis of the GRS GS measurements smoothed by a 2deg FWHM Gaussian function.

**Evidence for heterogeneous materials and layering?** The Cerberus Plains have been suggested to consist of flood lavas and plains style volcanism. The consistency of these hypotheses with the GRS results is studied via the macroscopic absorption cross section of terrestrial analogues. Columbia Plateau flood basalts and Snake River plains basalts have been identified as possible terrestrial analogues of the Cerberus Plains [1]. These basalts have very low Cl and $SO_2$ contents. Consequently, they have very low macroscopic absorption cross sections, which is consistent with the low absorbing material detected by the Neutron Spectrometer.

However the Cerberus Plains may not consist entirely of basalt because its low thermal inertia has been interpreted to result from a thin layer of soil covering the bedrock. Soils are richer in chlorine in comparison to rocks [8], suggesting that the composition of the region has vertical layering. This may explain the apparent discrepancy between interpretations of the neutron and gamma rays data sets, which both assumed the absence of layering initially.

Possible contributions from the surrounding regions must also be considered due to the large response function of the instruments. In conclusion we interpret the GRS observations by the presence of heterogeneous materials in the region of Cerberus and variations of the chlorine content in the close subsurface over a large area.

**Support of simulations:** To validate the proposed geological scheme, we simulate the emission of neutron currents with the use of GEANT. GEANT is a code that simulates the transport of particles through matter. We use a model of martian material made of two layers. Chlorine being identified as the key chemical element in neutron absorption, different chlorine abundances are tested in this model. We thus estimate the behavior of neutron currents confronted to chlorine layering.

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