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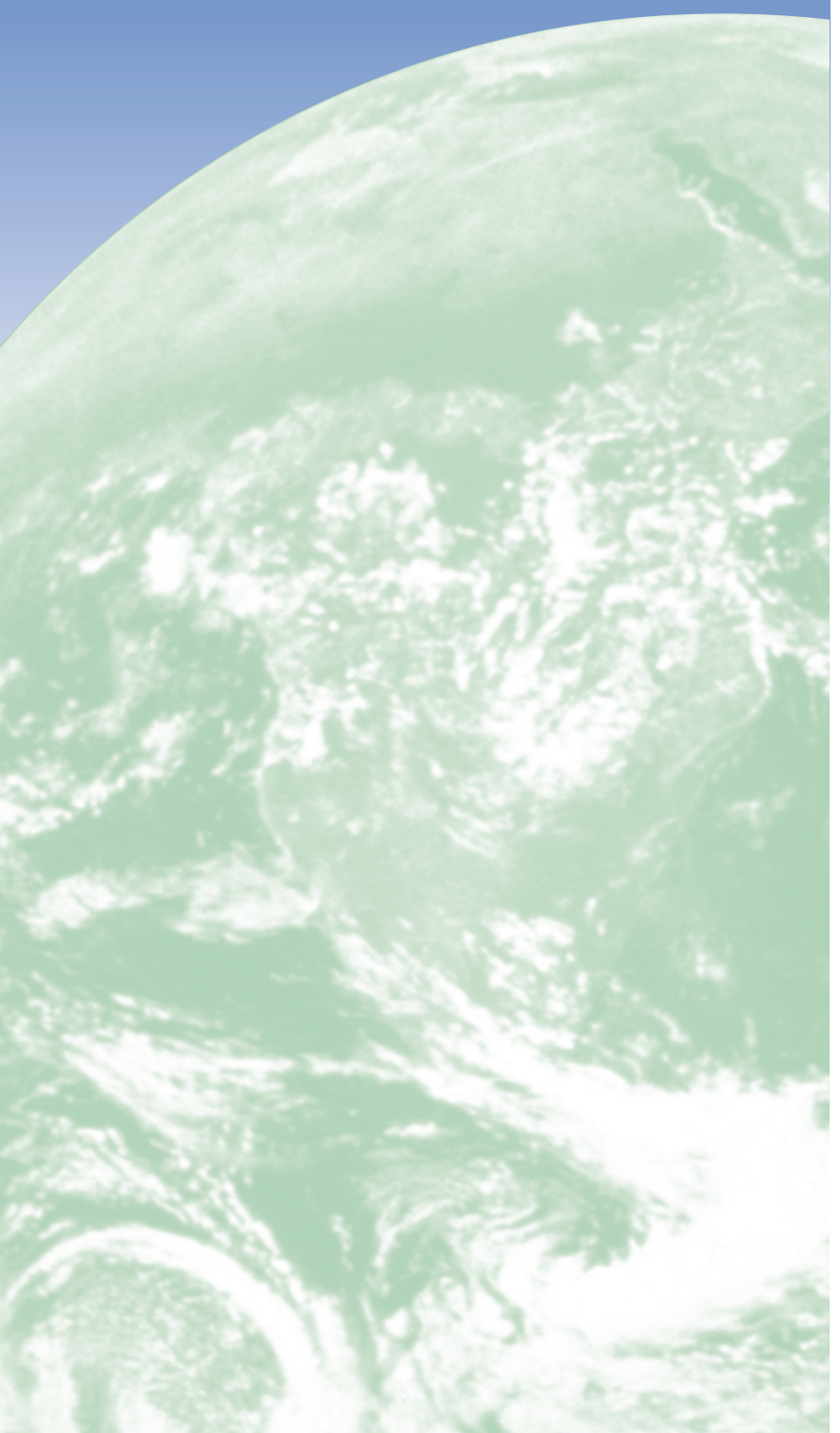

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## GA1.05/E/19-A5 1200

**PROPERTIES OF PARTIAL THERMOREMANENT MGANETIZATION IN PSD AND MD MAGNETITE GRAINS**

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An experimental study was carried out to investigate the thermal demagnetization properties of pTRM(T1,T2) imparted in different temperature intervals (T1,T2). Fifteen igneous rock samples and five synthetic specimens containing crushed and hydrothermally grown magnetite of different grain sizes were studied. The domain structures (DS) of the samples cover the range from SD to MD grains. Two different kinds of pTRM were considered: 1.) pTRMa(T1,T2) acquired when the upper temperature T1 is reached by cooling from the Curie temperature Tc and 2.) pTRMb(T1,T2) acquired by heating to T1 from room temperature. As was shown previously, the intensity of TRM(T1,T2) depends on the thermal pre-history of the sample, e.g. pTRMb(T1,T2) is not equal to pTRMa(T1,T2). Furthermore, any pTRM(T1,T2) has a tail that is not removed by thermal demagnetization to T1. The properties of pTRM(T1,T2) depend strongly on the temperature interval (T1,T2). Half of the natural samples under consideration have MD or PSD properties for the low-temperature pTRMs and typical SD-PSD behavior for the high-temperature pTRMs. A linear relation was found for MD samples where pTRMa(T1,T2)-pTRMb(T1,T2) = (intensity of the tail of pTRMa(T1,T2) after thermal demagnetization at T1). This relationship implies that the remanence carriers, which constitute the tail of pTRMa, do not contribute to pTRMb. The relative value of the tail is suggested as an independent means to evaluate the DS of a sample. The deviation in the Arai-Nagata plot from a straight line is proportional to the normalised value of the tail of pTRM(300,Tr), where Tr is room temperature. The presence and intensity of such a tail can be used as a test for suitability of a sample for paleointensity determinations with the Thellier method.

## GA1.05/E/21-A5 1220

**ROLE OF MAGNETOSTATIC INTERACTIONS IN ACQUISITION OF TRM AND VRM IN N ENSEMBLE OF SD GRAINS**

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A direct numerical calculations of susceptibility k of small number N=(2-20) interacting uniaxial SD grains, randomly dispersed over space, are carried out using the Boltzmann's distribution. The results of the calculations were averaged over 10000 randomly chosen configurations. For moderate interactions (the volume concentration c=(0.5-2)%) the dependence k(N) shows saturation. As expected the interactions lead to decrease of k in comparison with the susceptibility of non-interacting ensemble but the decrease does not exceed 20%. Hence for the practical purposes it is admissible to neglect the magnetostatic interactions when k of SD grains is considered. As a consequence, TRM depends on the interactions through increase of the blocking temperatures Tb mainly but not due to change of k(c). Limit value of VRM only slightly depends on the interactions but they drastically change the spectrum of relaxation time Tr. This leads to quasilogarithmic increase of VRM with time t even for the ensemble of non-interacting SD grains

# Friday 23 July PM

Presiding Chairs: Ö Özdemir (University of Toronto, Canada)
K Fabian (University of Bremen, Bremen, Germany)

## METHODS AND APPROACHES IN ROCK MAGNETISM

## GA1.05/E/02-A5 1400

**THE NEW THEORY OF THE RESIDUAL MAGNETISM OF MAGNETITE BEARING ROCKS**

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This theory comprises the following theses:
1.Residual magnetization (RM) of magnetite is generated by the inclusions of ferrimagnetic minerals represented, mainly, by hemoilmenites or magnesioferrites. Inclusions-free magnetite matrix can not to acquire RM.
2These inclusions, as a rule, are consisted of products (phases) of solid solution decay. On the contact of the each magnetic phase with magnetite matrix exchange interaction appears. This process induces exchange anisotropy, which creates the space energetic barrier in a magnetite grain. The barrier prevents retrieving of magnetite domain boundaries into position corresponding to demagnetized state. Thus, in RM of a magnetite grain the magnetization of the phases of inclusions appears, but matrix plays role of powerful amplifier of their weak magnetic moment. 3. Hence, the state of residual magnetization of magnetite is determined by the properties of the solid solution, namely: - by the number of the products of its decay and by their magnetic interaction between one another; - by the relaxation time of decay-homogenization process of solid solution and by its tolerance to the temperature changes.
All these theses have been proved experimentally and repeatedly tested. The new theory explains really all the known effects: the physical essence of the Rayleigh law, the cause of the offence of the Thellier laws, mechanism of self-reverse thermoremanence, origin of multi-component NRM, and the cases of chaotic diversity of its directions, which can not be removed with magnetic cleaning, etc.

## GA1.05/W/37-A5 1420

**JUXTAPOSED AND SUPERIMPOSED REMANENT MAGNETIZATIONS IN TWO FORMATIONS OF THE TINDOUF BASIN (ALGERIA)**

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email: henry@ipgp.jussieu.fr).

Two paleomagnetic studies in the West African Craton have been carried out in the Tindouf basin, in the Merkala red sandstones of the lower Stephanian age and in the Reouiana red sandstones of Namurian age. During thermal treatment, after elimination of a weak viscous magnetization A, two components B and C are clearly separated. B is isolated between 200-250°C and 550-580°C, and C at higher temperatures until 670°C. Rockmagnetic studies pointed out the presence of hematite and probably of magnetite.
On the one hand, the components B and C are well defined, with nice clustering and should represent a nice example of juxtaposed magnetizations. On the other hand, the angle between the mean directions of B and C appears remarkably constant, in value and in orientation, from one site to another. A strong relation exists therefore between B and C. B component is interpreted as resulting from the superimposition of the component C with an unknown component. To determine this component D, the intersection of great circles containing B and C directions has been studied. At Merkala, the component D has been obtained, and is a Permian overprint (paleomagnetic pole at 38.9°S and 60.0°E). At Reouina, the best intersection unfortunately corresponds to component C, which is therefore better grouped than D.
At Merkala, component C allows a lower Stephanian paleomagnetic pole to be defined: 32.4°S, 56.6°E. The Namurian pole determined with C at Reouiana is situated at 28.4°S, 56.9°E.

## GA1.05/E/07-A5 1440

**NATURE OF NATURAL REMANENT MAGNETISATION OF LOWER CRETACEOUS RED-BEDS OF AFGANO-TADJIK DEPRESSION (SOUTH TIEN-SHAN)**

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Natural remnant magnetisation of the rocks studied has chemical character, that is magnetic moments of the particles distributed in the rock have been oriented and fixed by the ancient magnetic field when the particles reach the some size. However, the other process affects the remnant magnetisation as well. This process appears as partial diagenetic transformation of hematite into maghemite, which lead to reversal magnetisation (in relation to original hematite) due to negative unidirect magnetic anisotropy. In the rocks studied this additional process lead to partial self-reversal remnant magnetising, and in some cases produces the full self-reversing of the magnetisation.

## GA1.05/W/05-A5 1500

**SECONDARILY ACQUIRED MAGNETIZATION OF CRETACEOUS GRANITIC ROCKS IN KITAKAMI MASSIF OF NORTHEAST JAPAN**

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Cretaceous granitic rocks of the Kitakami massif, whose K-Ar ages range between 107 and 120 Ma, are categorised into two types on the basis of paleomagnetic directions; (A) westerly direction with shallow inclination which is sub-parallel to the paleomagnetic direction of the Paleogene Heizaki volcanics and (B) northwesterly direction with moderate inclination which is sub-parallel to the paleomagnetic direction of the Early Miocene times for northeast Japan. Thermal demagnetization of the composite IRM shows that magnetite is carrier for hard and medium components in coercivity of both types. Alternating field demagnetization shows that Type A is characterised by low coercivity (less than 10 mT in MDF) whereas Type B reveals high median destructive field larger than 20 mT. Microscopic observation indicates that fairly large and euhedral magnetite occurs in neighbouring to biotites in Type A. In Type B, small grains of magnetites (less than 10 mm) are observed within alternating parts of hornblende where original green colour is bleached and becomes pale green. Studies by a scanning electron microscope equipped with a energy-dispersive analytical system show that a magnetite in Type A contains a small amount of Ti (the Fe/Ti ratio is 51.8) whereas a magnetite in Type B is free from Ti. The energy-dispersive analysis also shows that the bleached area in Type B reflects enrichment of Mg due to release of Fe. The pure magnetites within the bleached areas of Type B are originated from released Fe in hornblende, implying the secondary products. We conclude that origin of the remnant magnetization of Type B is CRM which is acquired by secondarily originated magnetites during alteration of rocks at about 20 to 30 Ma. Type A preserves primary magnetization, although its coercivity is low.

## GA1.05/E/16-A5 1520

**SIMULTANEOUS REMAGNETIZATION AND PB ISOTOPE RESETTING IN THE BAMBUÍ CARBONATES (BRAZIL)**

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Paleomagnetism, rock magnetism, U-Pb and Pb isotopic data on carbonates from the southern São Francisco basin support a close connection between a pervasive remagnetization and the resetting of the isotopic system of these rocks at 530-500 Ma, during the final stages of the Brasiliano/Pan-African orogeny. The post-depositional origin of the magnetization directions is strengthened by the following: (a) the rock magnetic properties, such as wasp-waisted hysteresis loops, anomalously high hysteresis ratios and contradictory Lowrie-Fuller and Cisowski tests, are typical of remagnetized carbonates; (b) thermomagnetic analysis and scanning electron microscopy suggest authigenic magnetite as the main magnetic carrier, and (c) paleomagnetic poles from carbonate sequences and adjacent Brasiliano metamorphic rocks are similar and coincide with high quality Gondwanan paleomagnetic poles for the 530-500 Ma interval. Most Pb-Pb and U-Pb ages from the carbonates coincides with ages of metamorphic rocks from marginal fold belts. In addition, undeformed carbonates containing radiogenic crustal Pb with an isotopic signature of the Archean/Paleoproterozoic basement suggest Pb incorporation through fluids which promoted the resetting of the isotopic system and the severe remagnetization in the carbonates. The similarity between paleomagnetic and isotopic resuts from the Bambuí and the 1000 km far Salitre carbonates implies a large scale event that simultaneously affected the whole basin.

## GA1.05/W/09-A5 1540

**INTERPRETATION OF MAGNETIC PROPERTIES OF ESTONIAN CARBONATE ROCKS USING FACTOR ANALYSIS**

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Magnetic susceptibility (k) and saturation isothermal remanent magnetization (SIRM) were studied together with bulk and grain density and chemical composition of Estonian Lower Palaeozoic carbonate rocks. Magnetic properties were analyzed on some 700 samples of argillaceous to varying degree limestones and dolomites of different genesis. The total database was subdivided into 6 data sets from Lower Ordovician up to Silurian age. To analyze together 17 parameters the R-mode factor analysis was applied. It permitted to determine the two principal factors controlling the alteration of magnetic properties and of two studied iron forms FeO and Fe2O3 . These factors are clay content and dolomitization. In the non-dolomitized carbonate formations magnetic susceptibility increases with increasing clay content, including both iron forms and in the rocks, which included impurities of iron oxides (Fe2O3). In the Lower and Middle Ordovician data sets with samples from widespread