



Magnetism of micas: a comparison between crystal chemistry and AC susceptibility.

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Although silicate minerals are the principal constituents of Earth's crust and mantle and iron is the most widespread magnetic element, few reliable studies on magnetic properties of iron-silicates were performed on natural samples, chemically and structurally well characterized. This work will address layer silicates magnetic properties, with special focus on micas, which, from a magnetic viewpoint, can be classified as bidimensional systems.

Iron in micas can be present as Fe^{2+} and Fe^{3+} and thus different magnetic properties can arise from their $3d^6$ and $3d^5$ electronic configuration. Furthermore, differences in magnetic properties can be related to coordination. In fact Fe^{3+} can substitute Si^{4+} in tetrahedral coordination in the phlogopite – tetra-ferriphlogopite join whereas Fe^{2+} can substitute Mg^{2+} in octahedral coordination in the tetra-ferriphlogopite – tetra-ferri-annite join.

Moreover, to preserve layer charge neutrality, other different mechanism can be introduced to compensate, for example, Fe^{3+} octahedral content.

In this work, we considered four natural mica samples, two belonging to the phlogopite – annite join (Tag15-4 e C6b), one to the tetra-ferriphlogopite – tetra-ferri-annite join and one to the polyolithionite – siderophyllite join.

Crystal-chemical data suggest differences in the amount of Fe^{2+} in octahedral coordination between samples Tag15-4 and C6b ($^{[6]}\text{Fe}^{2+} \approx 15$ e 50% respectively). Tetra-ferriphlogopite Tas22-1 is characterized by Fe^{3+} tetrahedral substitution and by small Fe^{2+} and Fe^{3+} content in octahedral position. Sample 103 shows Fe^{2+} and Fe^{3+}

in octahedral position with a preference for Fe^{2+} .

The susceptibility-temperature curves, related to AC magnetic measurements in the temperature range 77-298 K, suggest an antiferromagnetic behaviour for Tag15-4, C6b and Tas22-1, whereas the susceptibility-temperature of sample 103 is completely different.

The different behaviour of sample 103 can be related to structural disorder that prevents Fe atoms alignment in octahedral sites.

Moreover the magnetic magnitude is similar for C6b and Tag15-4 but differs substantially in Tas22-1, probably because of iron oxidation state and occupancy in the layer structure: mainly Fe^{2+} in octahedral sites for C6b and Tag15-4 and Fe^{3+} in tetrahedral sites for Tas22-1.