Magnetic Dactyloscopy as a New Technology for Exploration of the Finest Mineral Phases

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The knowledge of the phase composition is critical for mineralogy where the solid solution decay products not only define the magnetic properties of crystals, but also give valuable genetic information. However, the modern methods of microanalysis - electron probing and electron microscopy - cannot diagnose the solid solution decay products if their size is less than 1 micron and reaction to etching is identical.

On the other hand, such objects, if represented by ferro- or ferrimagnetic phases, can be diagnosed successfully using magnetic methods, since their resolution is independent of the size of particles, being controlled by their magnetic moment. Nevertheless, the traditional methods of magnetic analysis, such as the hysteresis loop survey or Curie point determination enable to get only the integral or "total" characteristics of substance, that, certainly, does not give any indication of its phase structure. For overcoming this "defect", the method of magnetic dactyloscopy (MD) was developed. It is based on the nonconventional concept of the nature of magnetic hysteresis of magnetically soft materials such as magnetite. In particular, it was established that the hysteresis properties of such materials are caused exclusively by the nature of magnetic inclusions and the matrix free of such inclusions cannot acquire remanence.

We can "feel" the finest particles immersed in a magnetically soft matrix even if their volume is shares of a percent of the sample volume, for their own minor magnetic moment increases by order 1-2 at the expense of a part of matrix vectors involved in the exchange interaction process. This circumstance allows determining the magnetic hardness, domain and magnetic structures of each solid solution phase, even if its size does not exceed shares of a micron.