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Palaeomagnetic, rock-magnetic and mineralogical investigations of metadolerites from Western Svalbard : A preliminary report

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A group of 42 independently oriented palaeomagnetic samples from 7 sites located in central part of the West Spitsbergen Thrust and Fault Belt has been investigated. The samples were collected from 5 distinct metadolerite sheets intruded into the Proterozoic – Lower Paleozoic metamorphic complex of Western Oscar II Land (Western Svalbard Caledonian Terrane – Harland, 1997 division).

All analyzed metadolerite samples were metamorphosed under greenschist facies metamorphism. The metamorphic assemblage consist of hornblende, biotite, actinolite, chlorite, epidote, stilpnomelane, titanite, albite, and quartz. Calcite, associated with pyrrhotite, pyrite chalcopyrite, sphalerite, and covellite, that occurs as irregular intergrowths or thin veins, document high activity of H_2O-CO_2-rich fluids during metamorphism. Primary magmatic phases represented by clinopyroxene occur rarely, and only in thick metadolerite dykes.

Accessory oxides change their mineralogical and chemical composition during metamorphism. In all examined samples primary Ti-magnetite and oxy-exsolved hematite break-down completely into titanite or have been dissolved. The ilmenite are also replaced by titanite, but in metadolerites at contact with host metapelites, slightly altered ilmenite grains with preserved hematite exsolution were documented. Basing on mineralogical observations it should be expected that metamorphic processes have almost completely reset the paleomagnetic data record from the time of dolerite crystallization. This stage can document only rare hematite oxy-exsolution preserved within ilmenite, and presumably small inclusion of magnetite still preserved within unaltered clinopyroxene. The paleomagnetic record of metamorphic stage is probably recorded by pyrrhotite, hematite, goethite, and late Ti-free magnetite that can grow during breakdown of pyrrhotite to pyrite (Ramdohr. 1980).

The NRM (Natural Remanent Magnetisation) intensities of the palaeomagnetic samples exceed the minimum 10 mA/m. The first AF/thermal demagnetizations have revealed a stable NRM structure. ChRM (Characteristic Remanent Magnetisation) components can be extracted precisely from Zijderveld diagrams (precision parameter – ASD max. 10º).

The following magnetic procedures have been applied to identify the ferromagnetic carriers of the samples: SIRM (saturation isothermal remanent magnetization) decay curves (procedure after Kadziałko-Hofmokl & Kruczyk, 1976) and the three-component IRM (isothermal remanent magnetization) procedure described by Lowrie (1990). Experimental work has revealed the dominance of pyrrhotite and magnetite phases as carriers with soft–medium coercivity (samples are saturated in 0.2–0.4 T) and distinct unblocking temperatures around 320-350 ºC and 575-600 ºC respectively.

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