CONTRASTING MAGNETIC LINEATIONS FROM WEST SPITSBERGEN FOLD-AND-THRUST BELT: INSIGHTS FROM ANISOTROPY OF OUT-OF-PHASE MAGNETIC SUSCEPTIBILITY AND ANHYSTERETIC REMANENCE

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ABSTRACT

We present results of a combined magnetic fabric study –anisotropy of in-phase magnetic susceptibility (ipAMS), out-of-phase susceptibility (opAMS), and anhysteretic magnetic remanence (AAMR)– from the Triassic mudstones of the West Spitsbergen Fold-and-Thrust Belt (WSFTB) and its foreland with the aim to interpret contrasting directions of magnetic lineations.

Keywords: Magnetic fabric, contractional tectonics, thrust nappes, simple shear

RESUMEN

Presentamos los resultados de un estudio combinado de fábrica magnética: anisotropía de susceptibilidad magnética en fase (ipAMS), susceptibilidad fuera de fase (opAMS) y remanencia magnética anhisteretica (AAMR), efectuado en las fangolitas triásicas de la faja de plegamientos y cabalgaduras West Spitsbergen (WSFTB) y la región de su antepaís con el objetivo de interpretar direcciones contrastantes de lineamientos magnéticos.

Palabras claves: Fábrica magnética, tectonica contraccional, nappes, cizalla simple

Explanation

Lateral shortening in a compressional tectonic setting can result in a wide range of strain regimes and structures: horizontal compaction with volume loss, pure shear, simple shear, formation of small-scale imbricated thrust sheets and/or detachment folds. We present results of a combined magnetic fabric study – anisotropy of in-phase magnetic susceptibility (ipAMS), out-of-phase susceptibility (opAMS), and anhysteretic magnetic remanence (AAMR) – from the Triassic mudstones of the West Spitsbergen Fold-and-Thrust Belt (WSFTB) and its foreland with the aim to explore which of the above strain regimes can be recorded in magnetic fabric.

The WSFTB is an orogenic range formed during the Eurekan orogeny by plate interaction between Greenland and the Canadian Arctic. The orogen forms a narrow, elongated structure and records 10–40 km margin-perpendicular shortening.

In general, the ipAMS fabric is oblate, the opAMS and AAMR fabrics range from oblate to prolate (Figure 1). Magnetic foliation (MF) of phyllosilicate-controlled ipAMS is parallel to the bedding plane, and magnetic lineation (ML) is parallel to the bedding strike. On the contrary, the opAMS and AAMR fabrics (both almost coaxial) are different. While MF of opAMS and AAMR is also parallel to the bedding plane, ML does not parallel the bedding strike, but lies close to bedding dip. Both opAMS and AAMR fabrics are likely controlled by minor magnetite being partially in superparamagnetic state. ML

of opAMS and AARM thus reflect the preferred orientation of long axes of magnetite grains. Magnetic fabric was modelled mathematically for a set of oblate (phyllosilicate) and prolate (magnetite) particles in viscous matrix, to assess the assumed scenario of (1) deposition of detrital phyllosilicates, (2) vertical compaction, (3) diagenesis and a growth of randomly-oriented magnetite, (4) subsequent thrusting/ simple shearing. It was demonstrated that in such cases simple shear can result in creating two mutually perpendicular lineations created by prolate particles (magnetite; parallel to shear direction) and oblate particles (phyllosilicates; perpendicular to shear direction). Contrasting magnetic fabrics of ipAMS vs. opAMS and AAMR provide thus information about depositional and tectonic processes. On regional scale, MLs of opAMS and AAMR may thus indicate the thrusting directions.

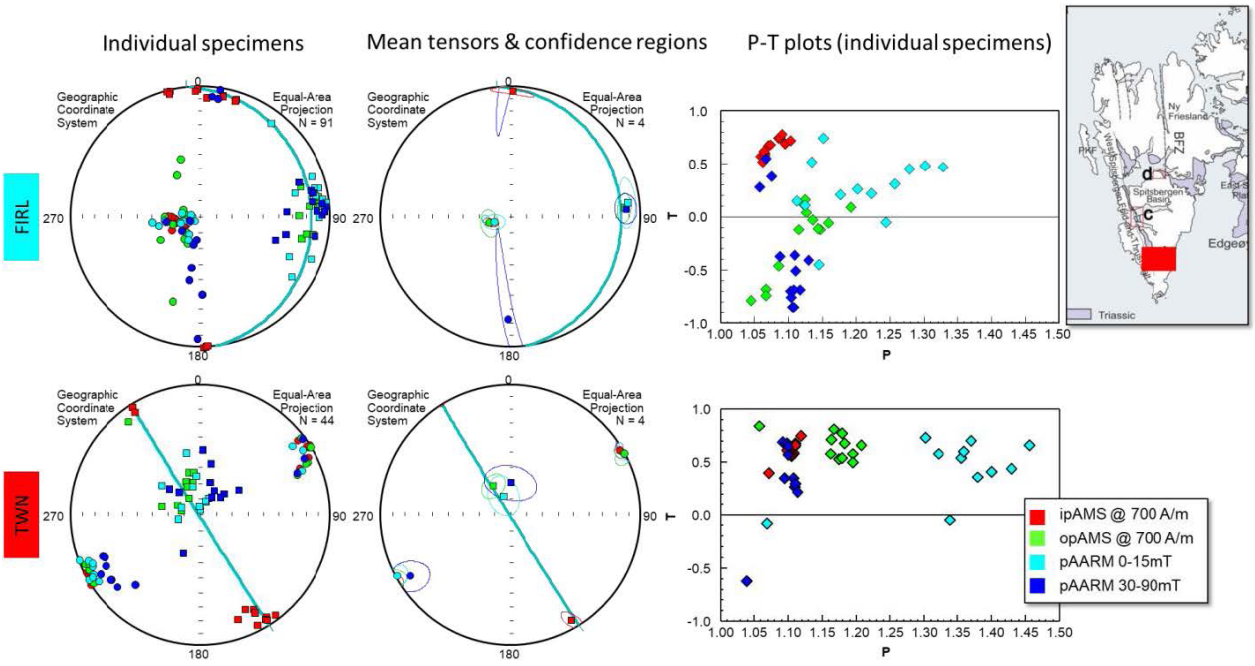

Figure 1: Magnetic fabric of two representative sites from the West Spitsbergen Fold-and-Thrust Belt.

In the foreland of the WSTFB (Figure 2), the strata are sub-horizontal, gently dipping northwest. An inverse ipAMS fabric, that is prolate with sub-vertical lineation perpendicular to the bedding, is sometimes observed due to the presence of Fe-rich carbonates. Both opAMS and AAMR fabrics, however, are normal with respect to the bedding, oblate with magnetic lineation being parallel to the bedding strike.

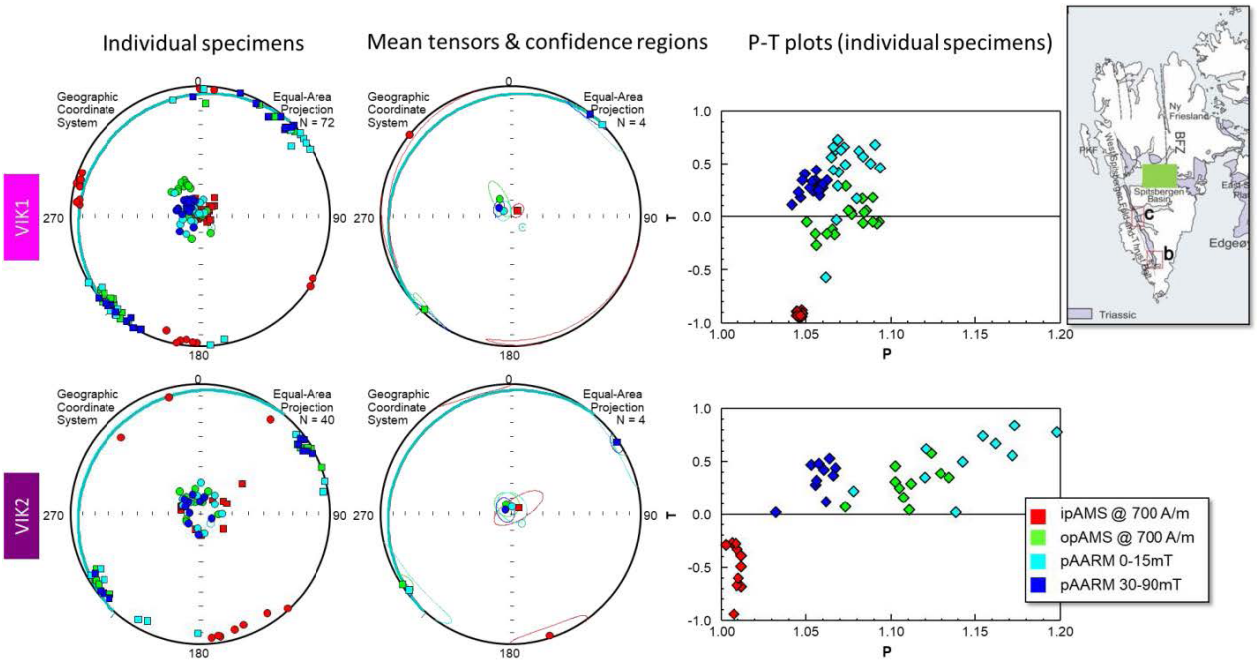

Figure 2: Magnetic fabric of two representative sites from the foreland of the West Spitsbergen Fold-and-Thrust Belt.