NGU Rapport 93.088

Palaeomagnetic dating of fault rocks from Vesterålen, Senja and Troms. Preliminary data

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REPORT

Report no. 93.088 | ISSN 0800-3416 | Grading: ~~Confidencial~~ Open

Title:

Palaeomagnetic dating of fault rocks from Vesterålen, Senja and Troms. Preliminary data.

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Client:
NGU

County:

Commune:

Map-sheet name (M=1:250.000)

Map-sheet no. and name (M=1:50.000)

Deposit name and grid-reference:

Number of pages: 12 Price:

Map enclosures:

Fieldwork carried out:	Date of report:	Project no.:	Person responsible:
	19.06.93	61.2574.00	Jan S. Rønning

Summary:

A preliminary palaeomagnetic study has been carried out in Vesterålen, Senja and Kvaløya (Troms) in order to furnish temporal constraints on near offshore fault-activity in the Lofoten area. At Senja, two phases of faulting and brecciation have been identified. A young phase, attendant on the formation of fault-gouges, is Recent/Tertiary in origin, whereas an older phase has a Permian age. A Permian age (c. 260-270 Ma) is also indicated from heamatite cemented fault-breccias from Kvaløya, and the Permian fault-activity probably witnesses an early rift-phase on the continental margin. Permian fault-rocks (c. 260-270 Ma) are also widespread within the Møre-Trøndelag Fault Zone (Central Norway) and Western Norway.

Keywords:	Geofysikk	Paleomagnetisme
Forkastning	Datering	Perm
		Fagrapport

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PALAEOMAGNETIC DATING OF FAULT ROCKS FROM VESTERÅLEN, SENJA AND TROMS : PRELIMINARY DATA

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INTRODUCTION

Palaeomagnetic studies of fault rocks furnish a direct technique in dating phases of fault movements or rejuvenation. The success of the method, however, requires several assumptions (Torsvik et al. 1992a; Trench et al. 1992) to be satisfied which we reiterate below:

(1) Remanence must be unaffected by the structural grain (deflection).
(2) Well-defined reference data or an established apparent polar wander path (APWP) is required.
(3) Unaccounted-for post-acquisitional structural rotations are precluded.
(4) An appropriate sampling strategy is required.
(5) The observed magnetic mineral(s) must relate to mineral growth during significant fault displacement rather than later fluid movements along the same fault zone.

PALAEOMAGNETIC RESULTS

A total of 51 drill-cores/hand-samples were collected from Vesterålen, Senja and Kvaløya (Troms) in order to furnish temporal constraints on near offshore fault-activity in the Lofoten area (Fig. 1).

Kvaløya:

Samples from Kvaløya embraces a zone of several generations of crush-breccias and the younger breccias show clear evidence for a late phase of fluid circulation and precipitation of hematite giving the fault-rocks a distinct dark red colour.

The natural remanent magnetization (NRM) is carried by the high-stability haematite. NRM directions have SW declinations and negative inclinations. The stability of NRM was tested by means of thermal demagnetization which demonstrate a stable and single component magnetization which is unblocked at around 650-660°C (Fig. 2). 8 tested samples yielded identical directional results (Fig. 3).

Vesterålen:

Two localities were sampled from Vesterålen. Location 1 embraces pseudotachylites (thin veins; mm scale) and host-rocks (banded gneisses), whereas location 2 comprised pseudotachylites and a mafic dyke. Palaeomagnetic studies demonstrate that pseudotachylites, banded gneisses as well as the mafic dyke have the same magnetic directions (Fig. 4), hence they may witness a regional overprint magnetization direction.

Senja:

The sampled locality from Senja covers a wide brecciated zone which show evidence for at least two phases of brecciation. The youngest fault-movements produced fault-gouges; fault-rocks are dominated by steep northerly magnetizations of Recent/Tertiary origin (see group marked LB in Fig. 5). A mafic dyke, located within the zone of brecciation, however, shows evidence for two remanence directions; one similar to LB directions found in fault-rocks and a second direction (group HB in Fig. 5) which is similar to fault-rock directions found on Kvaløya (compare Figs. 5 and 3).

INTERPRETATION

At least two phases of faulting and brecciation is identified at Senja. The youngest phase (fault-gouges) is Recent/Tertiary in origin (Fig. 5; group LB), almost obliterating an older Permian phase (see discussion below). In Figure 6, pre-Tertiary palaeomagnetic results from Vesterålen (V), Senja (S; Group HB in Fig. 5) and Kvaløya (K) are compared with the reference APWP for Baltica (Torsvik et al. 1992b). It is evident that the results from the two latter areas plots close to the Permian part of the APWP path, and it is therefore evident that important phases of on-shore faulting and/or phases of fluid circulation (breccia cementation) took place at that time (c. 260-270 Ma). This fault-activity is probably linked to the near off-shore tectonic evolution, and probably witnesses an early rift-phase on the continental margin. More sampling (June 93), however, and extensive laboratory experiments is required to date these events precisely (say to within 10 million years). A similar bipolarity of Permian (and also younger) magnetizations against faults have been observed within the Møre-Trøndelag Fault Zone (Grønlie & Torsvik 1989) and Western Norway (Torsvik et al. 1992a).

The palaeomagnetic results from Vesterålen indicate an early Palaeozoic magnetic overprint. The palaeomagnetic data, however, is removed from the reference APWP (Fig. 6) which may suggest that the area has suffered younger rotations or tilting. Accounting for seaward block-tilting in order of 15-20 degrees on a NE tilt-axis would bring the Vesterålen results in correspondence with the Ordovician section of the APWP for Baltica.

CONCLUSION

A preliminary palaeomagnetic study has been carried out in Vesterålen, Senja and Kvaløya (Troms) in order to furnish temporal constraints on near offshore fault-activity in the Lofoten area. At Senja, two phases of faulting and brecciation have been identified. A young phase, attendant on the formation of fault-gouges, is Recent/Tertiary in origin, whereas an older phase has a Permian age. A Permian age (c. 260-270 Ma) is also indicated from heamatite cemented fault-breccias from Kvaløya, and the Permian fault-activity probably witnesses an early rift-phase on the continental margin. Permian fault-rocks (c. 260-270 Ma) are also widespread within the Møre-Trøndelag Fault Zone (Central Norway) and Western Norway.

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FIGURE 1 *Geographic location of sampling area. K=Kvaløya, V=Vesterålen & S=Senja.*

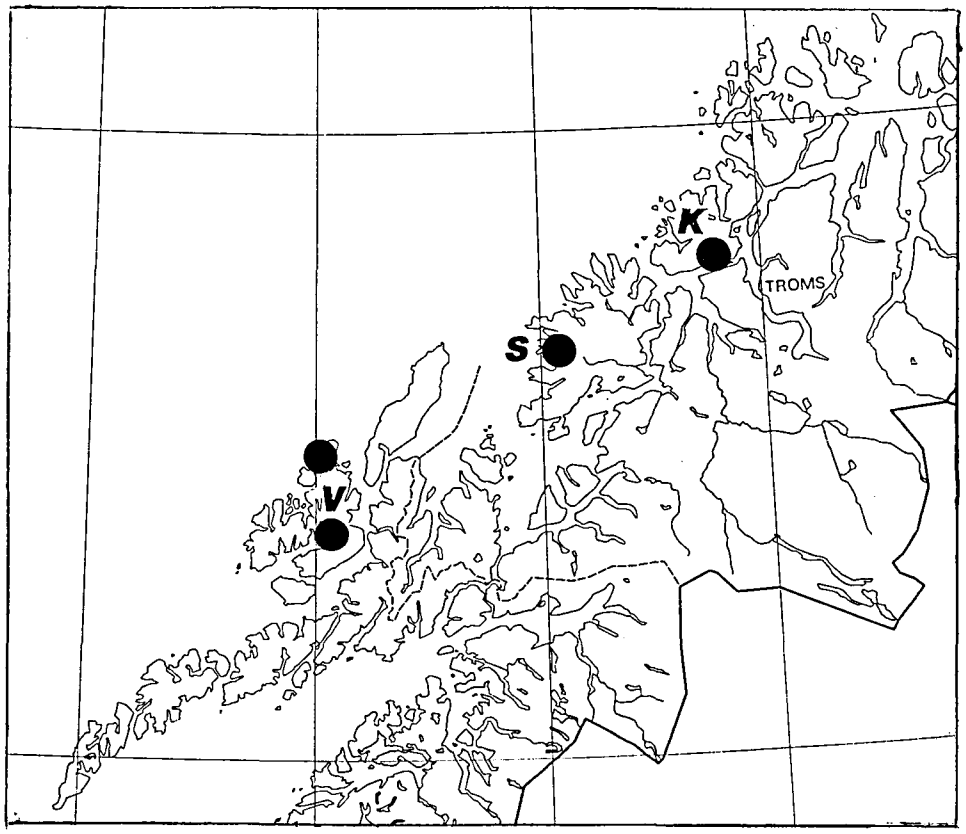

FIGURE 2 *Example of stepwise thermal demagnetization of a breccia sample from Kvaløya. In steroplots, open (closed) squares denote negative (positive) inclinations.*

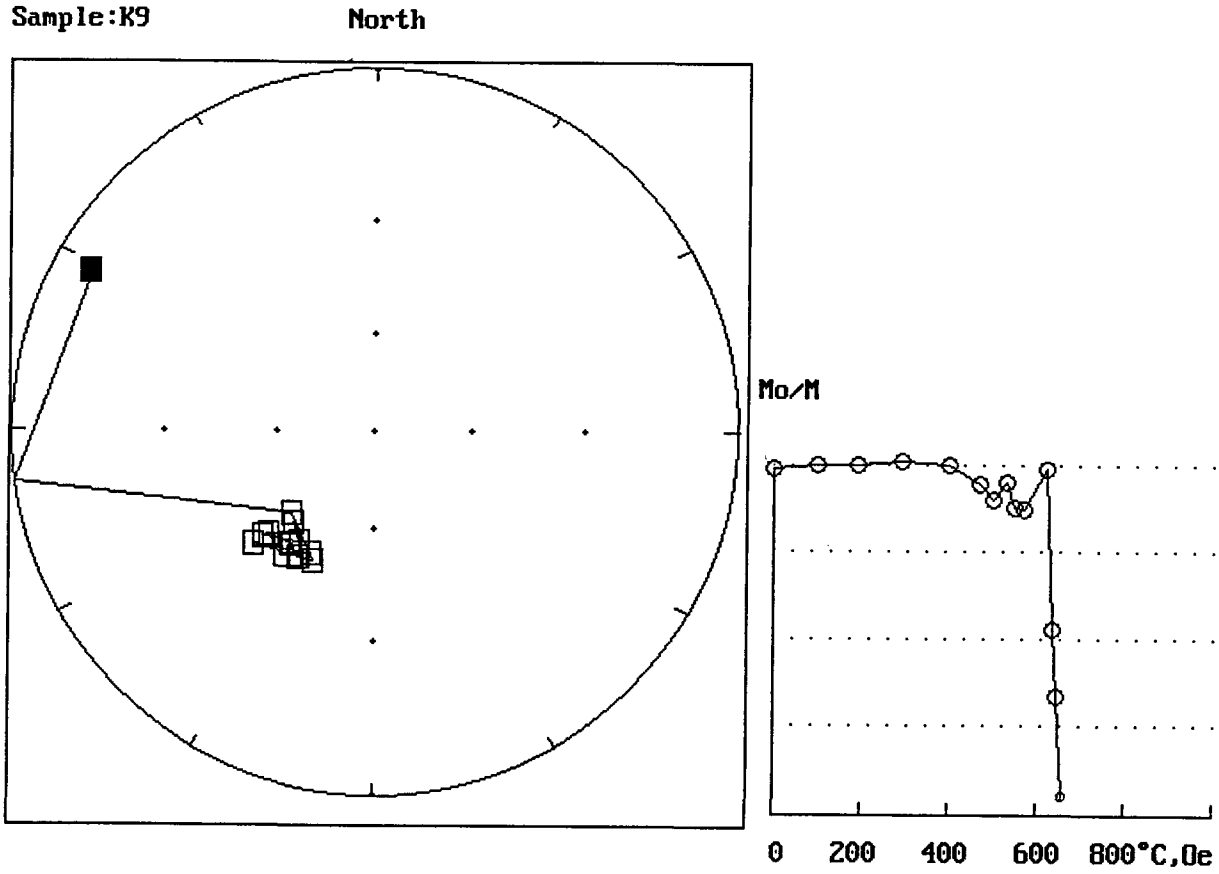

FIGURE 3 *Distribution of characteristic remanence components, i.e. components identified via thermal demagnetization, from Kvaløya. Note the good cluster around 217/-40.*

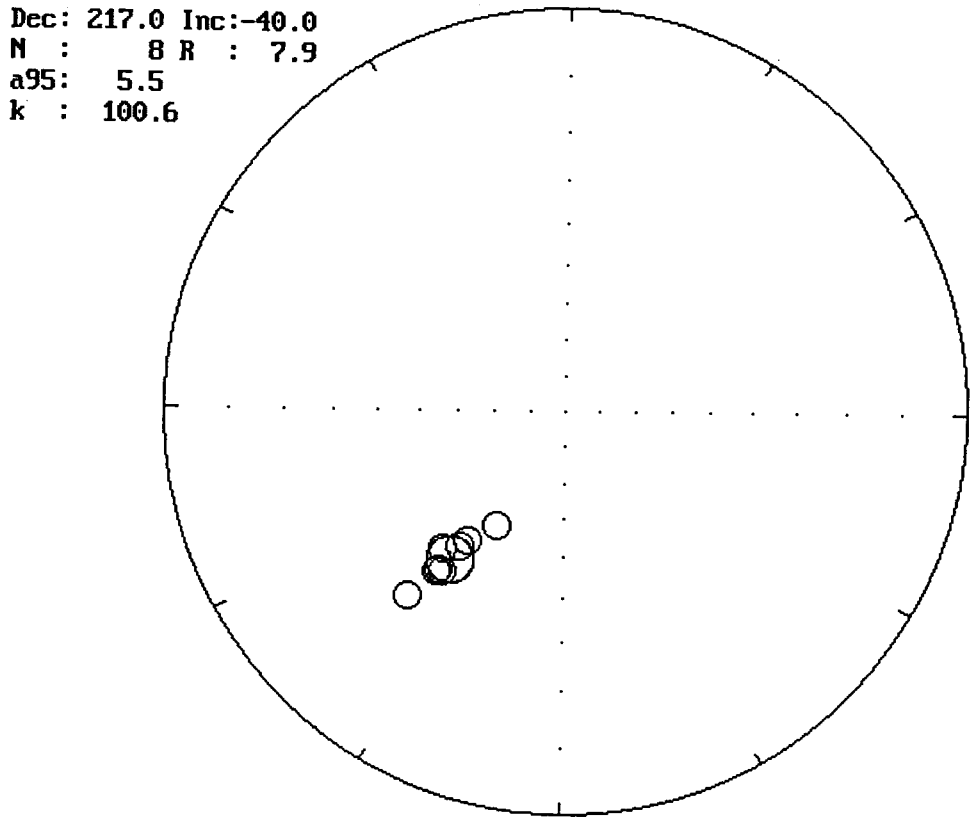

FIGURE 4 *Distribution of remanence components from Vesterålen, including migmatites, pseudotachylites and dykes. Note the directional discordance with Kvaløya.*

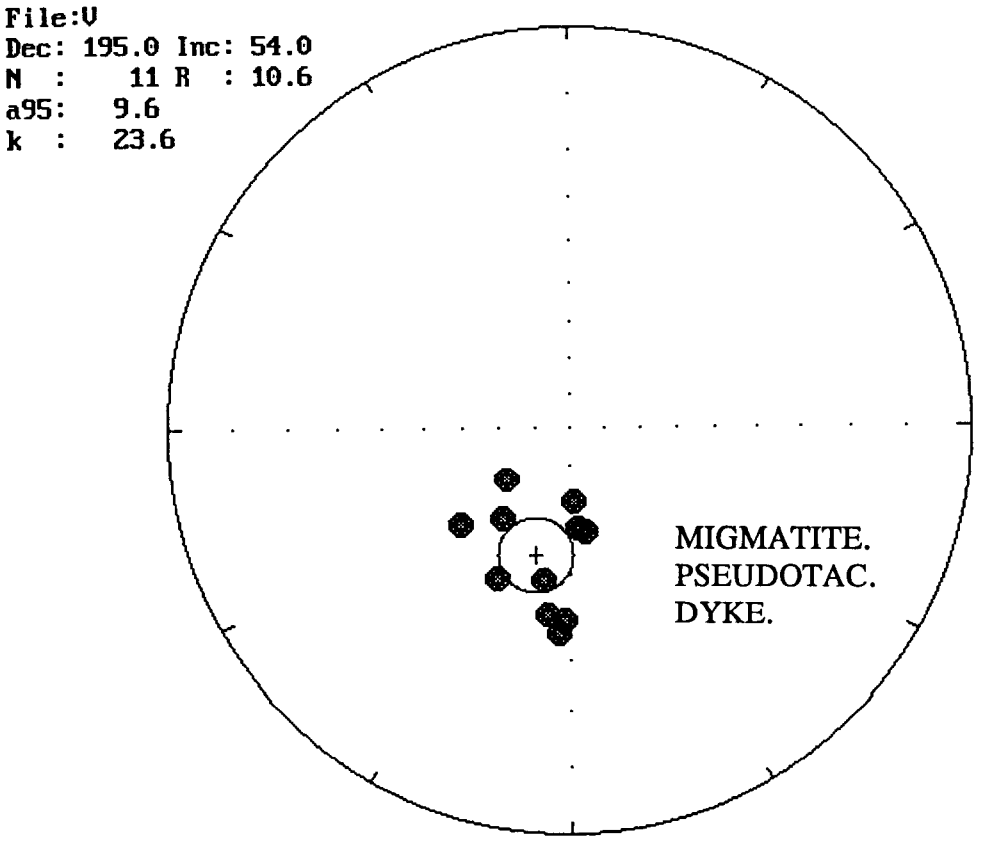

FIGURE 5 *Distribution of characteristic remanence components from Senja. LB=Low unblocking components, HB=High unblocking components. LB plots close to the present earth magnetic field, whereas the two HB components compares with directional data from Kvaløya.*

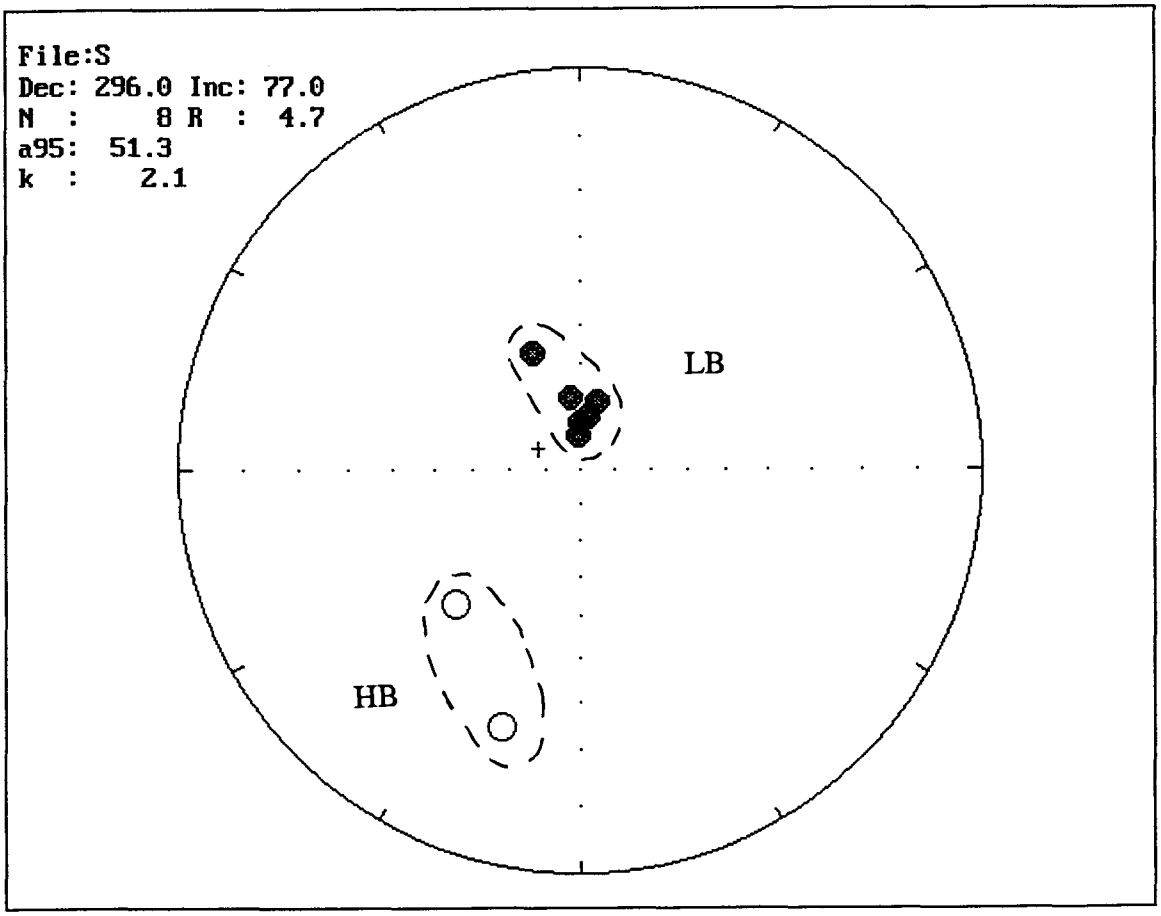

FIGURE 6 *Calculated palaeomagnetic poles from Kvaløya (K), Vesterålen (V) and Senja (S - HB components in Fig. 5) displayed together with the reference apparent polar wander path (APWP) for Baltica (Torsvik et al. 1992). Note that poles from Kvaløya and Senja indicate a Permian age, whereas the Vesterålen pole (probably an regional overprint - uplift magnetization) is incompatible with any parts of the APWP. However, accounting for possible tilting of Vesterålen in the order of 15-20º would bring the Vesterålen pole in correspondance with the Upper Ordovician part of the APWP (see stipled line).*