On buoyancy and diapirism as drivers for exhumation of the eclogite-bearing basement infrastructure in the southern Scandinavian Caledonides

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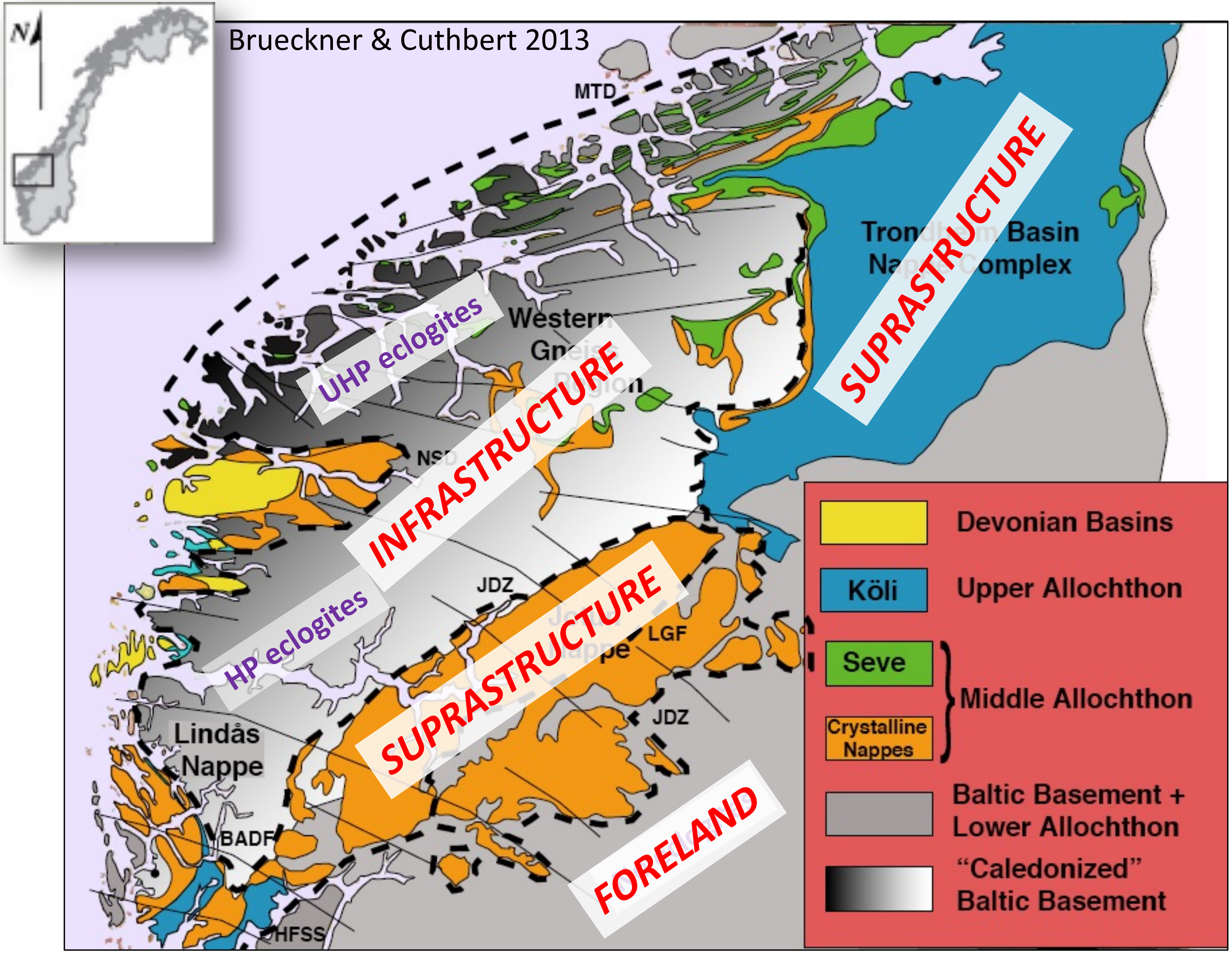
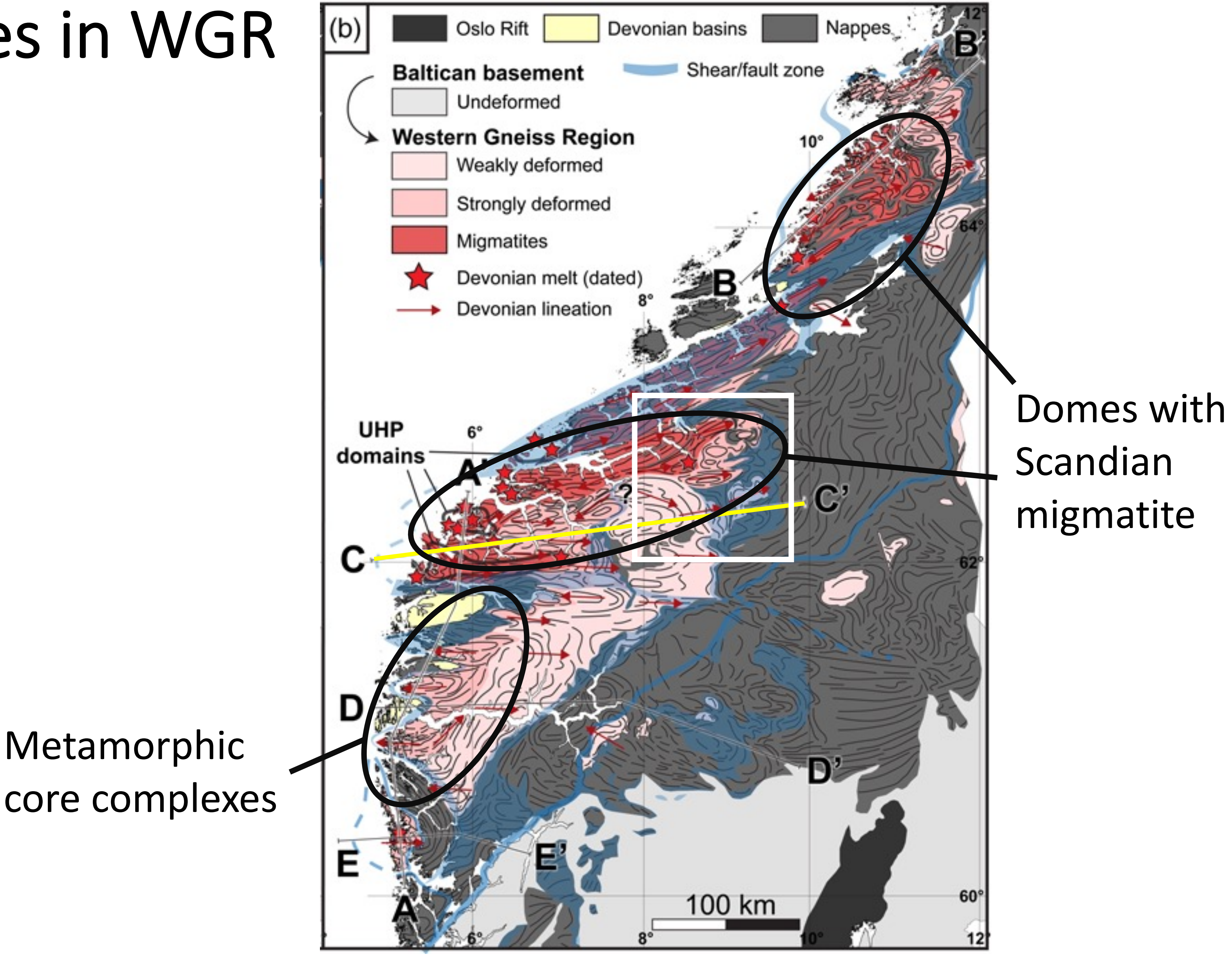
What role do ductile, mobile and buoyant migmatites play in the transport and final emplacement of eclogites?
What can this tell us about the dynamics of the Caledonian orogenic infrastructure?

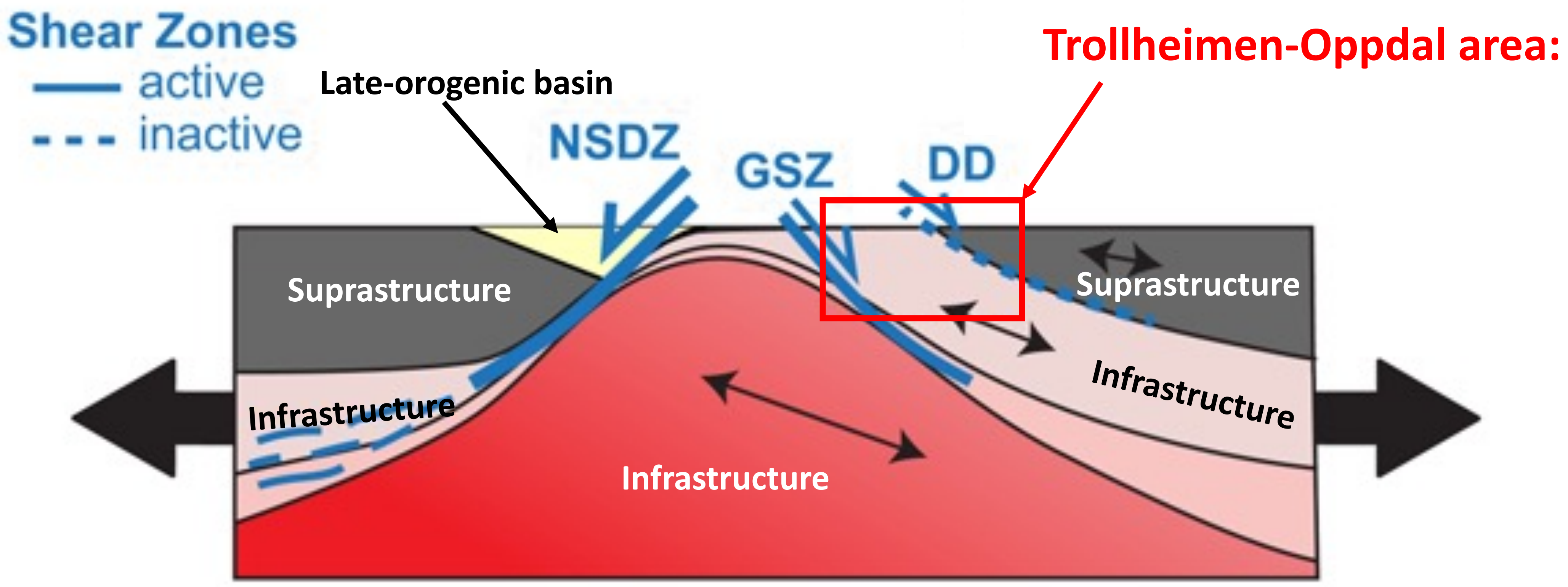

Brueckner & Cuthbert 2013
N
MTD
Trondheim Basin
Nappe Complex
SUPRASTRUCTURE
Western
Gneiss
Region
UHP eclogites
INFRASTRUCTURE
NSD
HP eclogites
JDZ
SUPRASTRUCTURE
Jotun
Nappe
LGF
JDZ
Lindås
Nappe
BADF
HFSS
FORELAND
Devonian Basins
Köli
Upper Allochthon
Seve
Crystalline
Nappes
Middle Allochthon
Baltic Basement +
Lower Allochthon
"Caledonized"
Baltic Basement

Foliation domes in WGR

Weist et al. (2022)

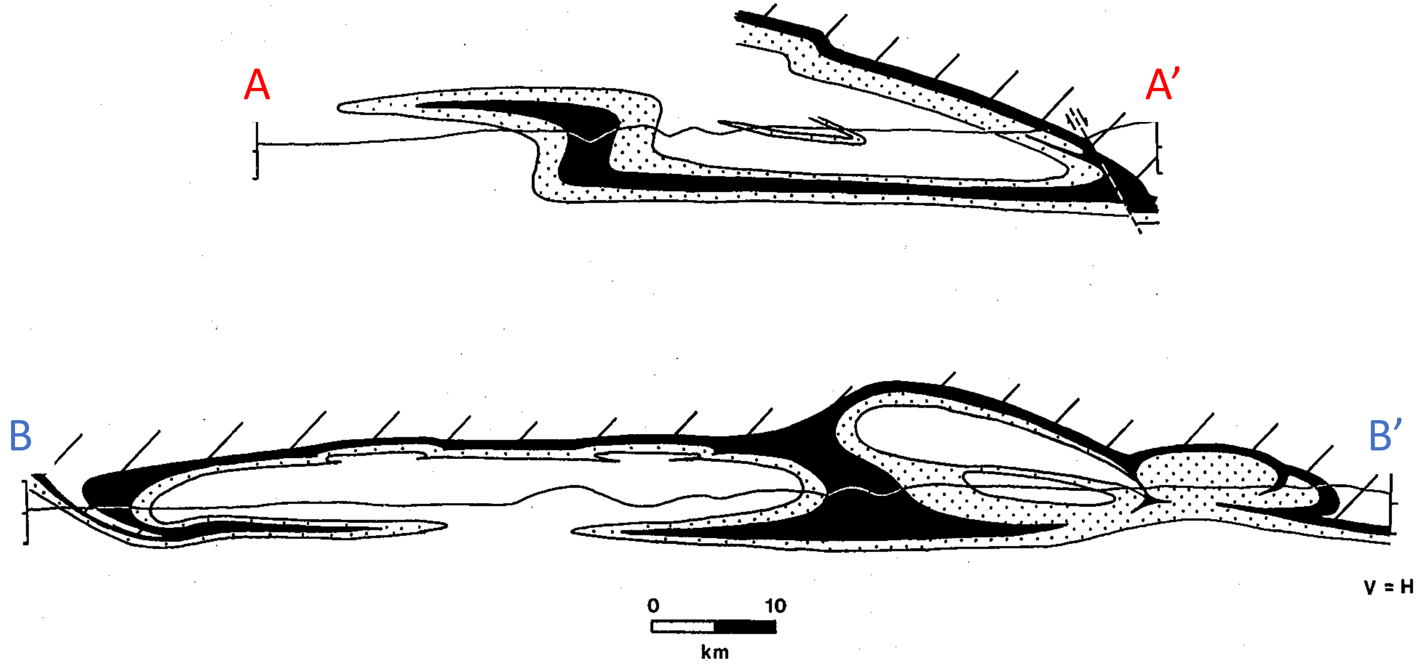


Infrastructure - suprastructure architecture in the WGR (Weist et al., 2022)

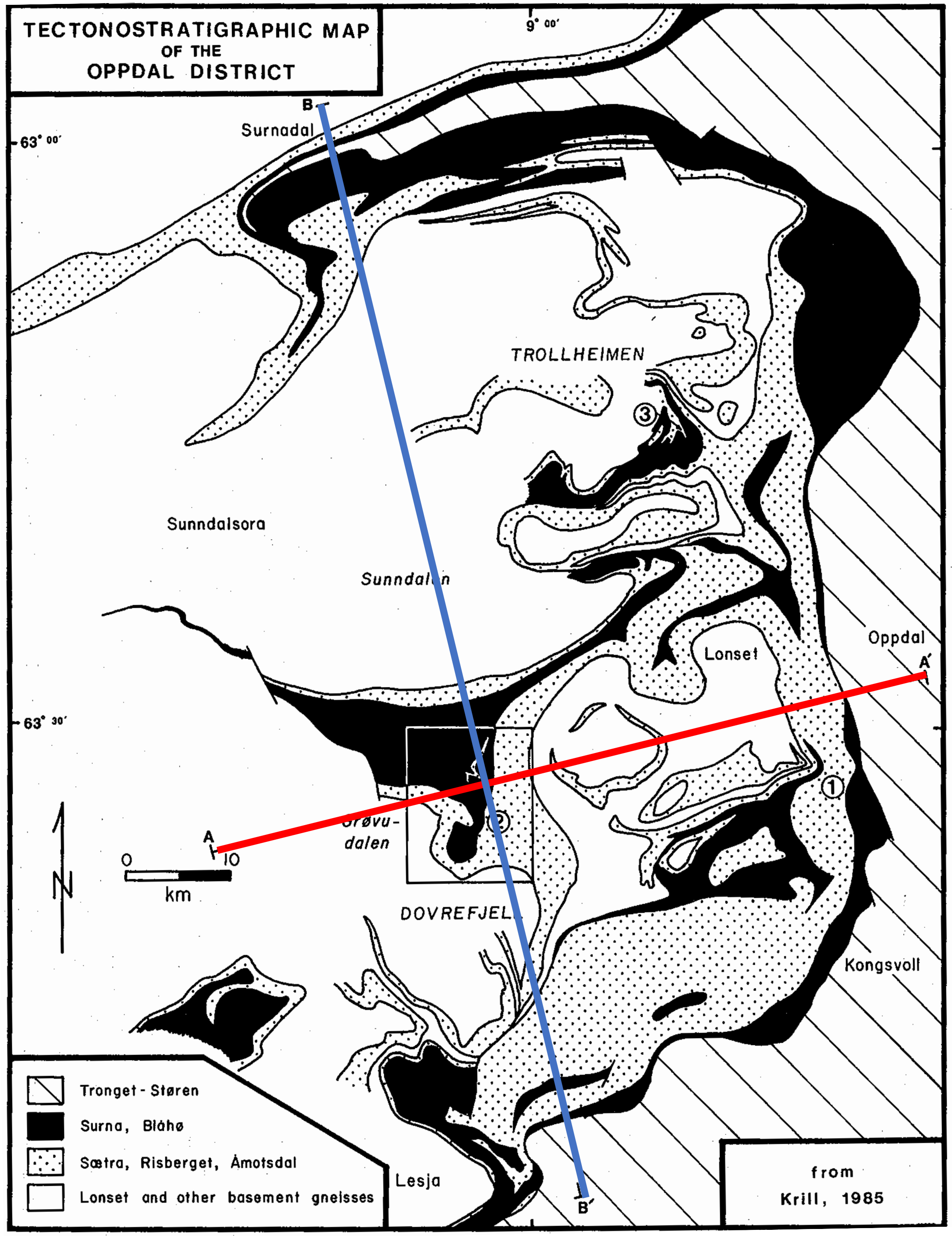


Spreading gneiss domes in the Trollheimen-Oppdal area

Krill (1985); Vollmer (1988)

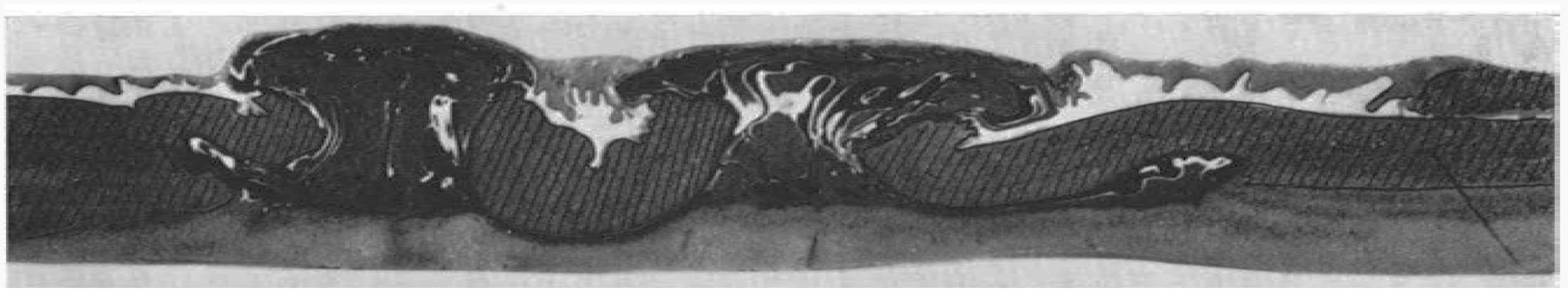


(NB - Vollmer (1988) proposed an alternative interpretation of E-vergent sheath nappes)

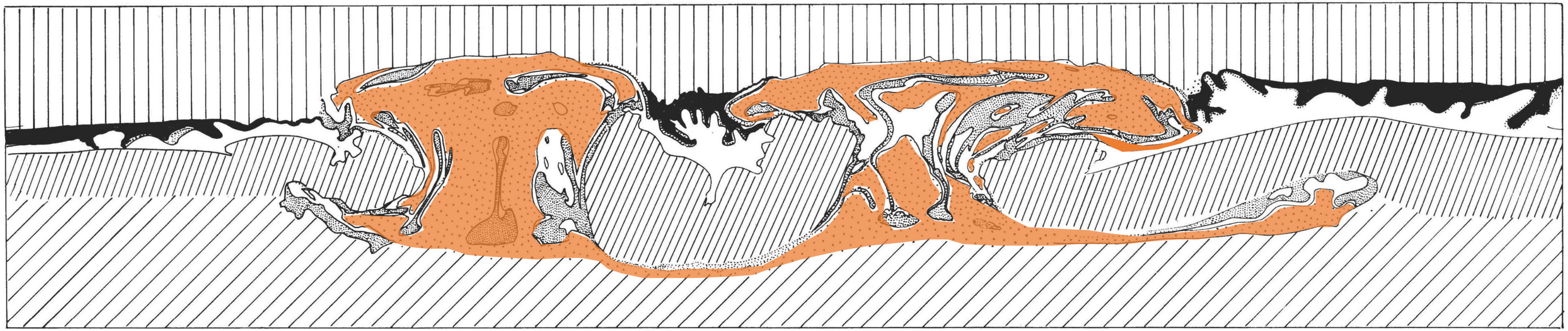


Ramberg's centrifuge modelling of gravity structures

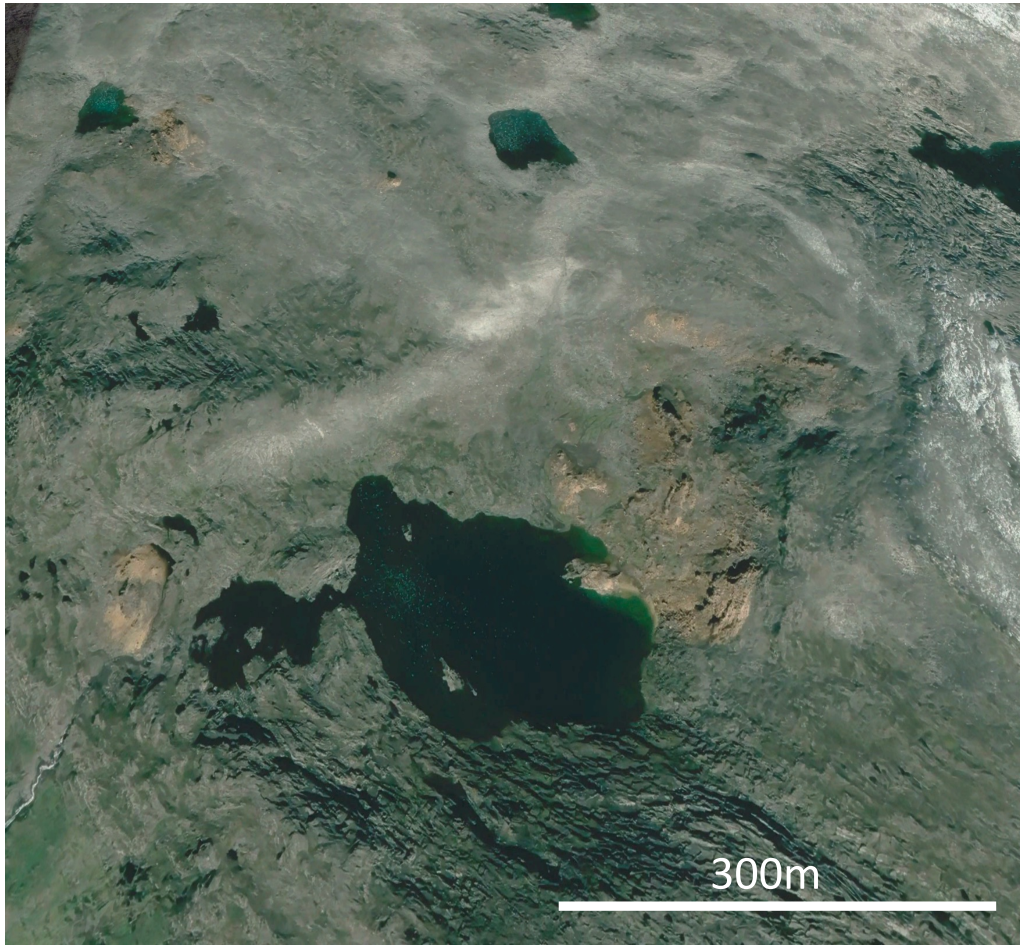
Ramberg (1966)



NB – model set-up allows no gross horizontal extension or shortening



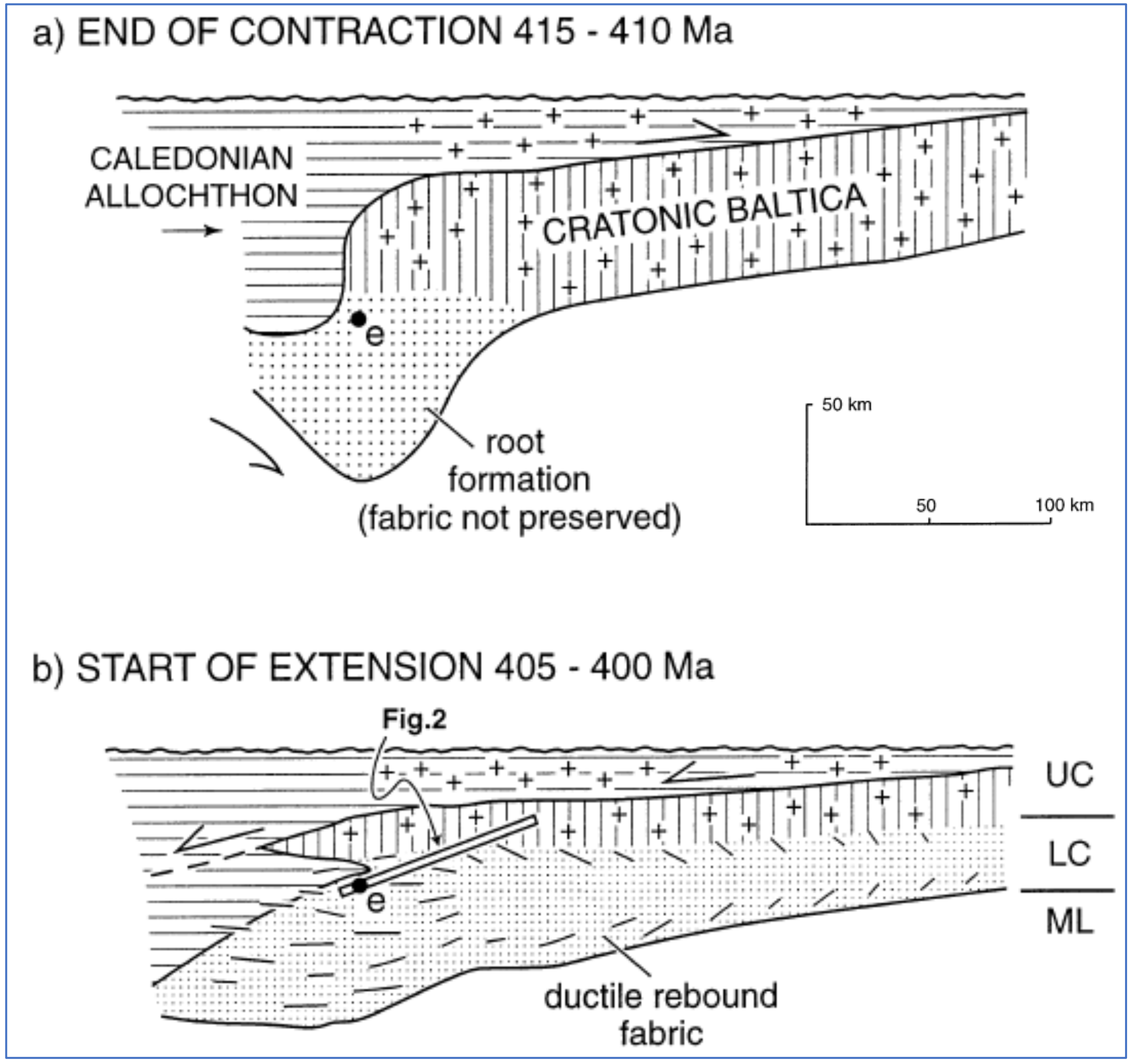
How were the gneisses and their cargo of eclogite and mantle peridotite translated from the subduction zone and emplaced under the orogenic superstructure?



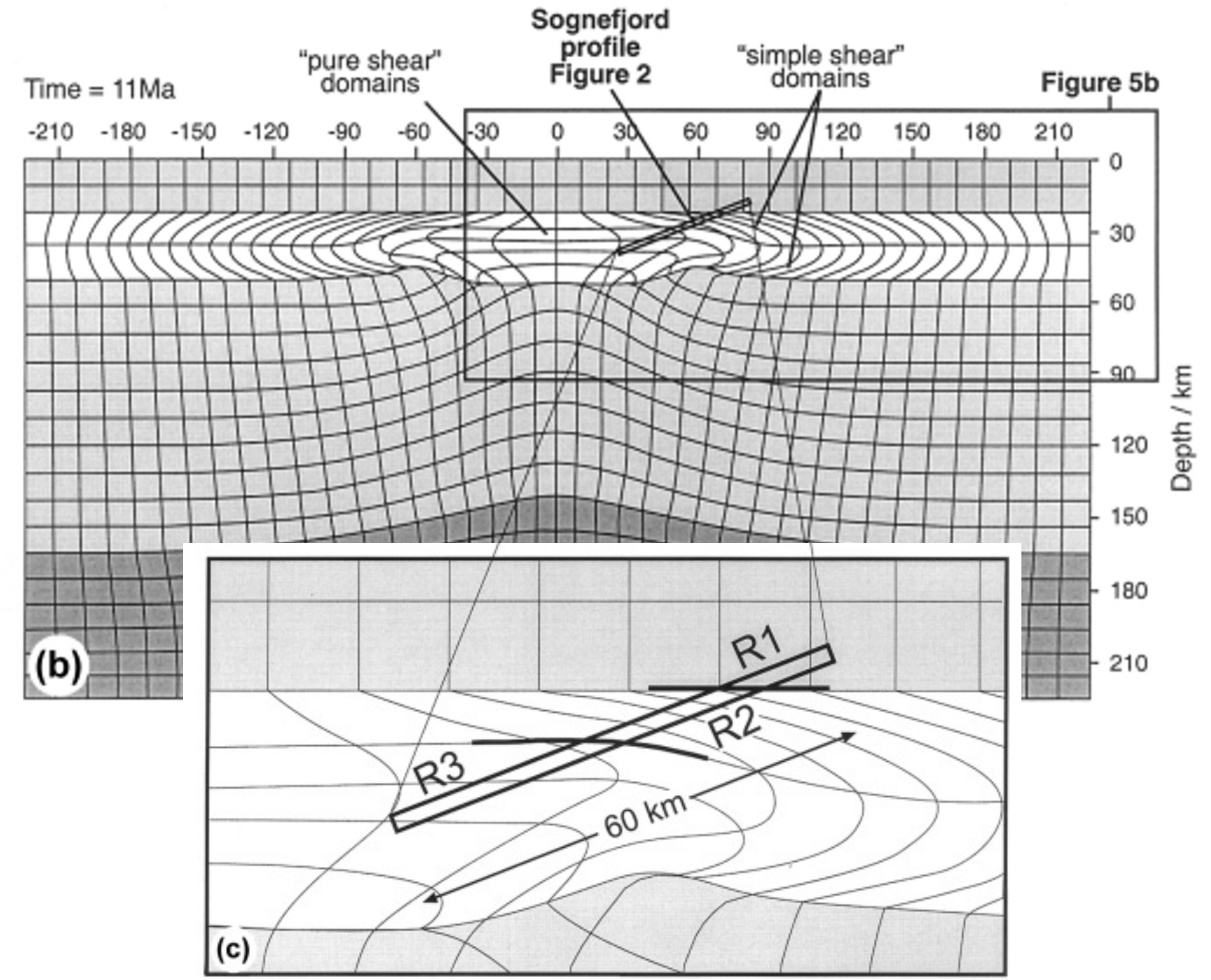
Rebound and ductile tunneling – Sognefjord section

Koyi et al. (1999); Milnes & Koyi (2000)

Kinematic model

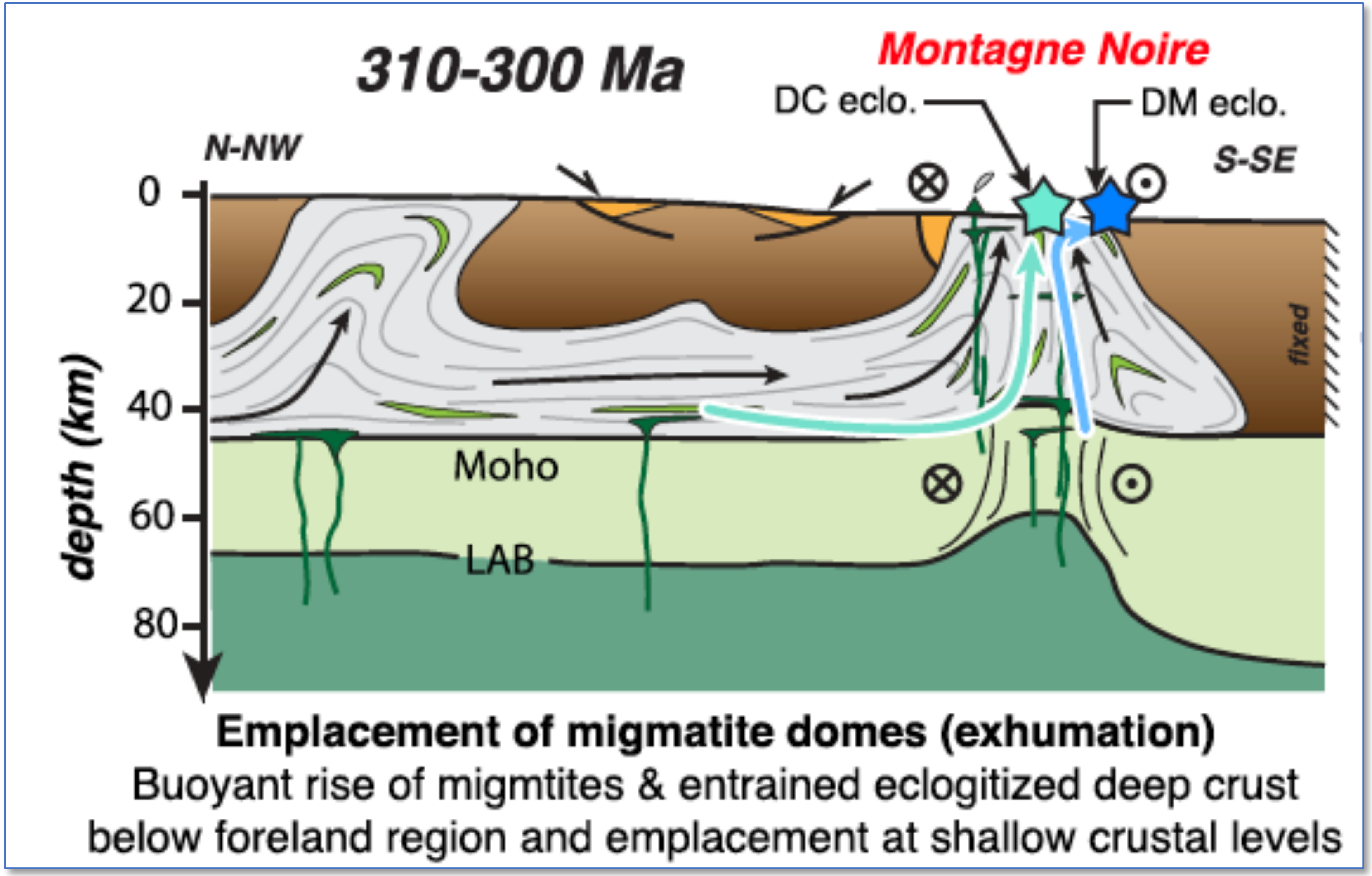


Dynamic model



Ductile tunnelling, gneiss domes and eclogites – Variscides

Hamelin et al. 2022



<u>Note</u> transport of eclogite inclusions – "*in-situ*" and entrained

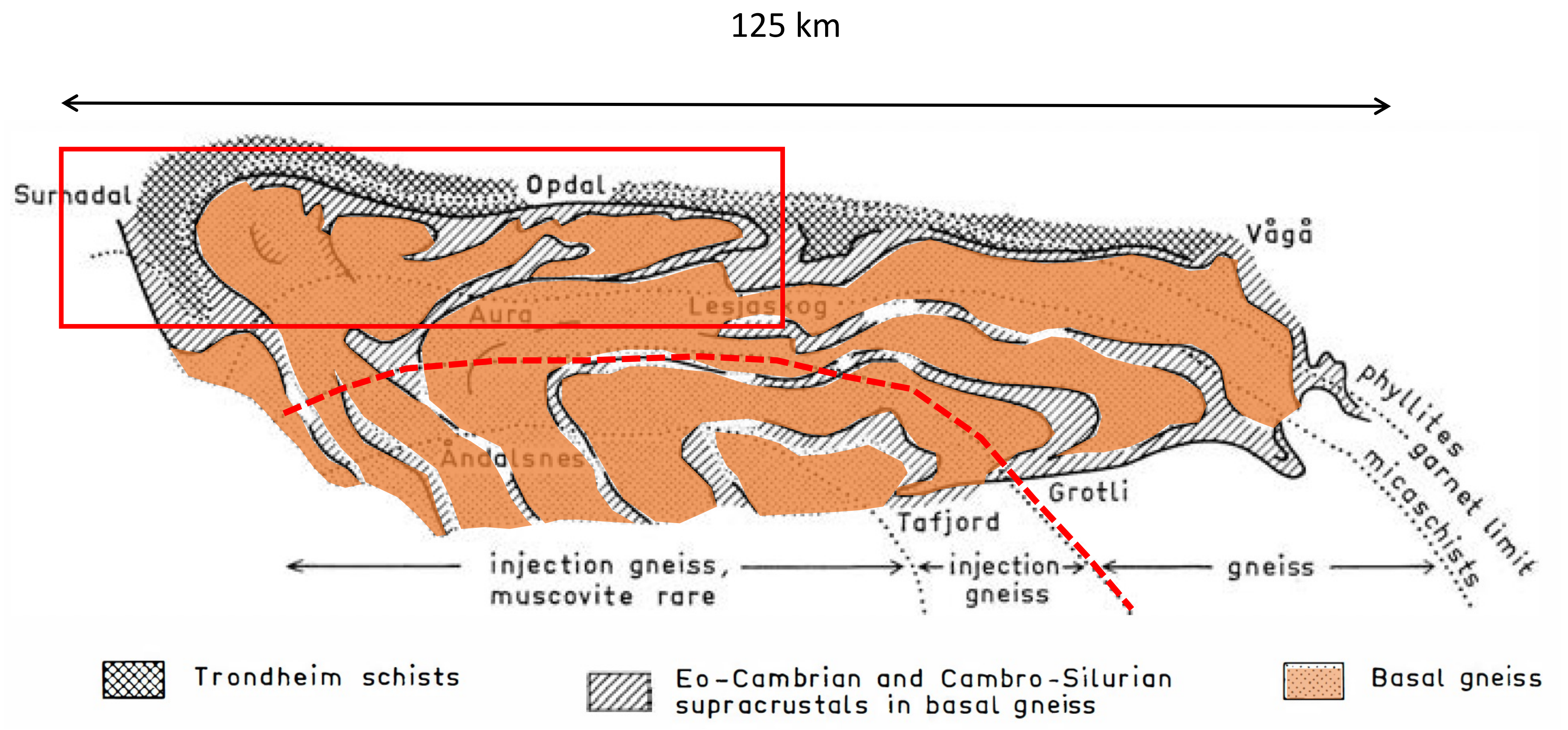
Conclusions

A review of the available literature indicates:

- Final exhumation of eclogite-bearing basement gneisses in the Caledonian orogenic infrastructure was associated with:
  - ➢ *Major extensional and transtensional structures (MCC's?)*
  - ➢ ***Diapir-like gneiss domes** possibly cored by migmatite*
- Translation of continental crust from the subduction zone to the sites of final emergence involved foreland-directed a "***ductile tunnelling***" mechanism.
- Ductile flow of buoyant crust has the potential to transport dense eclogite bodies but also entrain them from the lower crust or upper mantle (i.e. **some are not "*in-situ*"!***).*
- Diapiric gneiss-doming and tunnelling may have been an important mechanism by which ***the orogenic infrastructure dissipated its heat***.
- ***Future studies*** should include more detailed mapping of Caledonian partial melting and metamorphic patterns in the orthogneisses and wrapping allochthons and studies of kinematics in the eastern gneiss domes of the WGR.

Additional information follows…

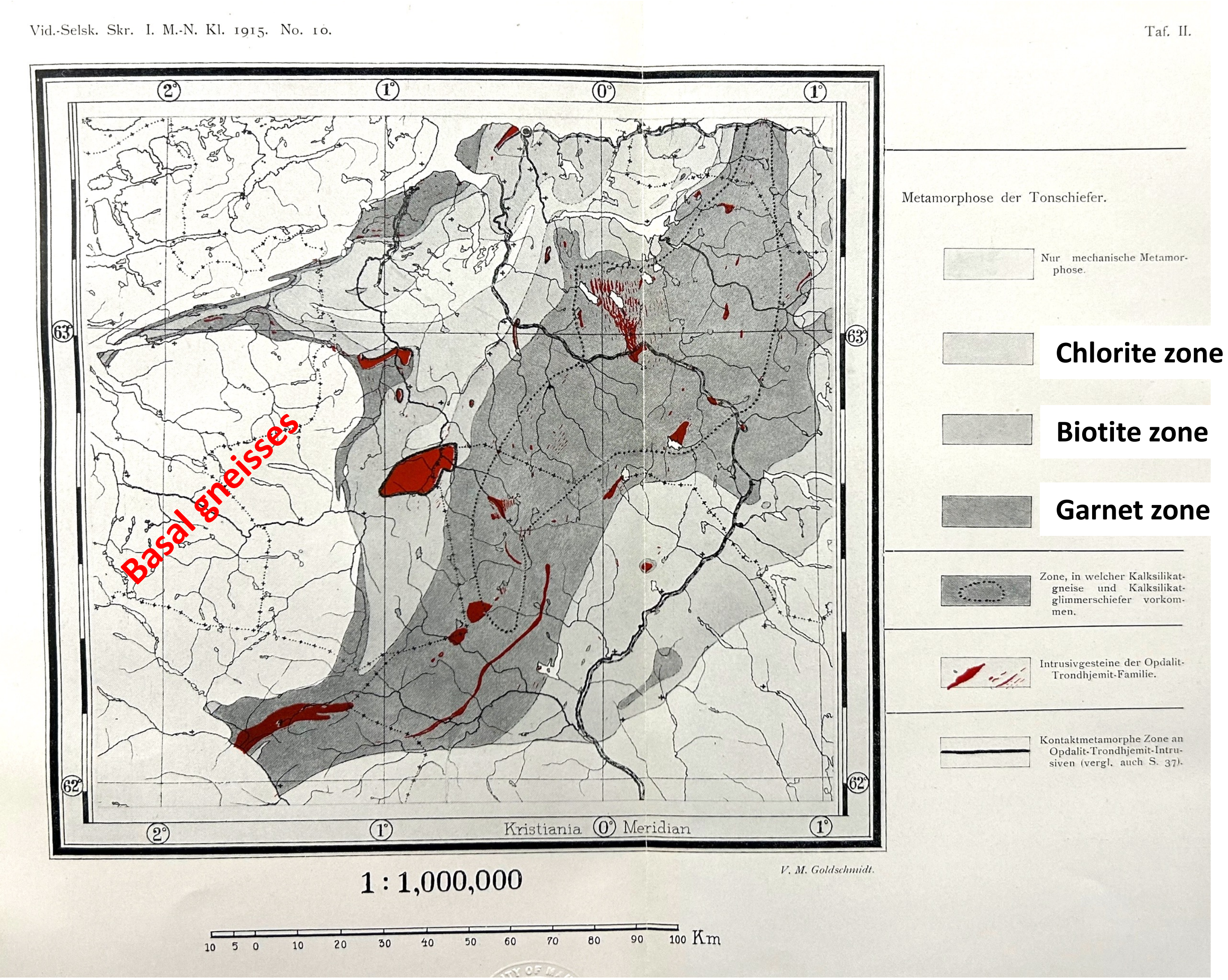
Large-scale cross-section from Muret (1961)



Larger-scale structural interpretation across the central WGR showing a "spillover" structure similar to that generated in Ramberg's analogue models

Metamorphic effects of basement gneiss domes?

V. M. GOLDSCHMIDT: *GEOLOGISCH-PETROGRAPHISCHE STUDIEN IM HOCHGEBIRGE DES SÜDLICHEN NORWEGENS III DIE KALKSILIKATGNEISE UND KALKSILIKATGLIMMERSCHIEFER DES TRONDHJEM-GEBIETS*. VIDENSKAPSSELSKAPETS SKRIFTER. 1. MAT.,NATURV. KLASSE. 1915. No: IO



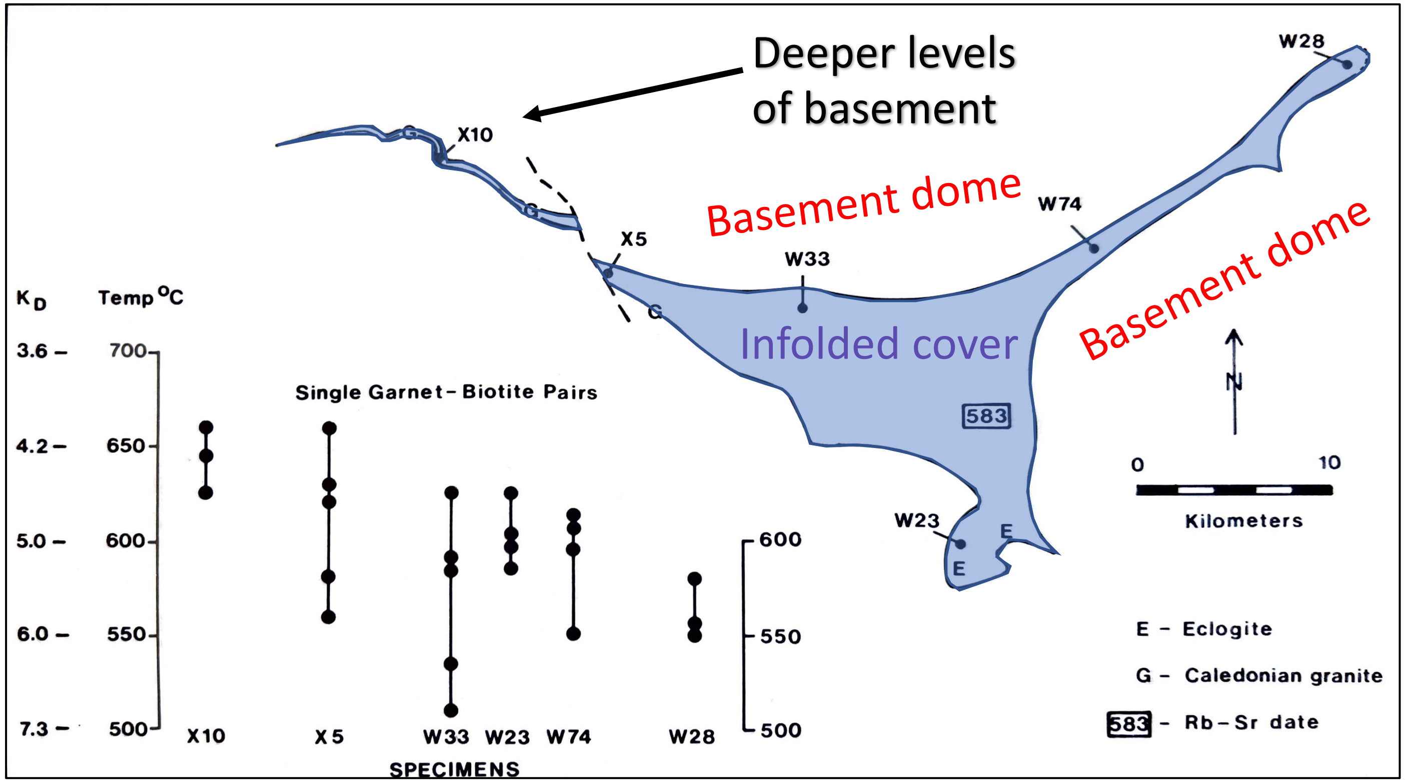
Classic study of zonal metamorphism by Goldschmidt (1915).

Note peripheral increase in grade towards basal gneisses in the west.

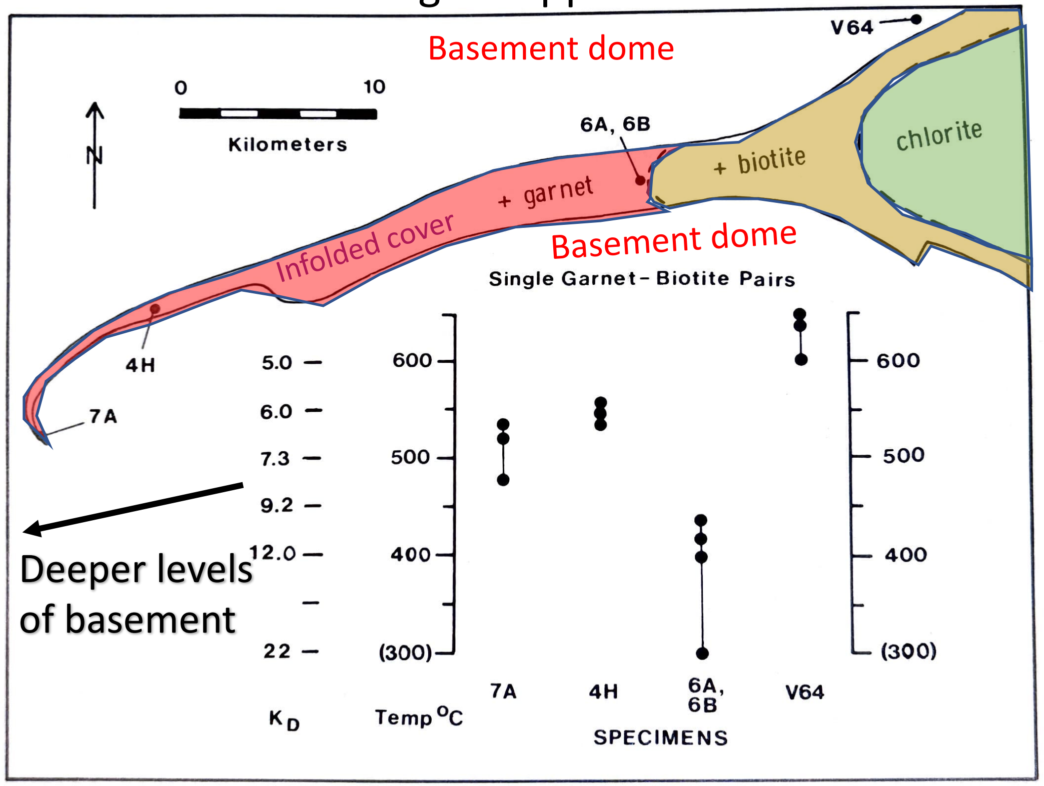
Metamorphic effects of gneiss domes?

From Krill 1985 - Oppdal area

Surna/Blåhøa nappe infold



Tronget nappe infold



Grade of pelites in infolded keels of allochthons between domes increases with structural depth (i.e. adjacent to deeper levels of adjacent basement gneiss)