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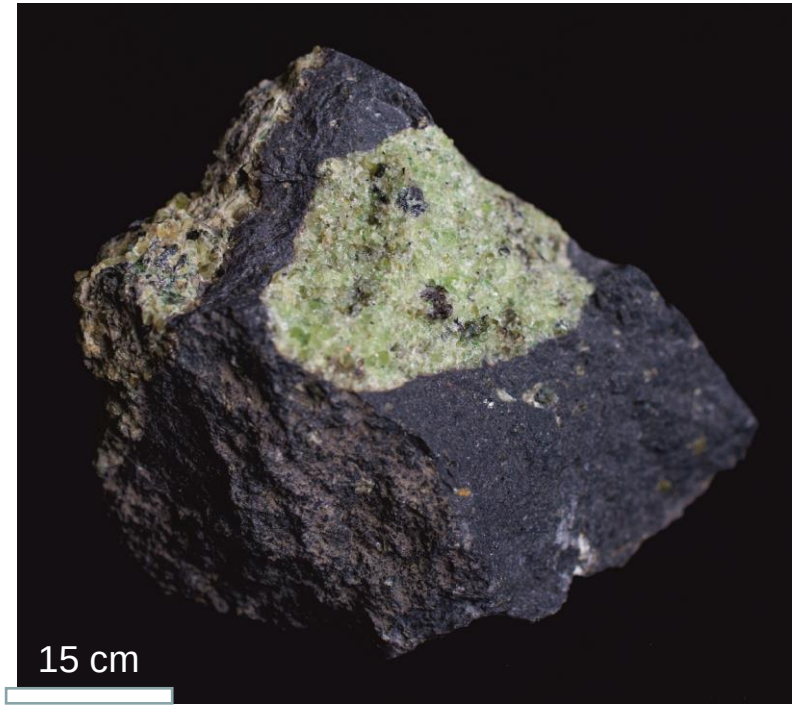
Faculty of Natural Sciences, Comenius University

Xenolits in basalts - an unique source of information on the composition and properties of the lithosphere

Monika Huraiová



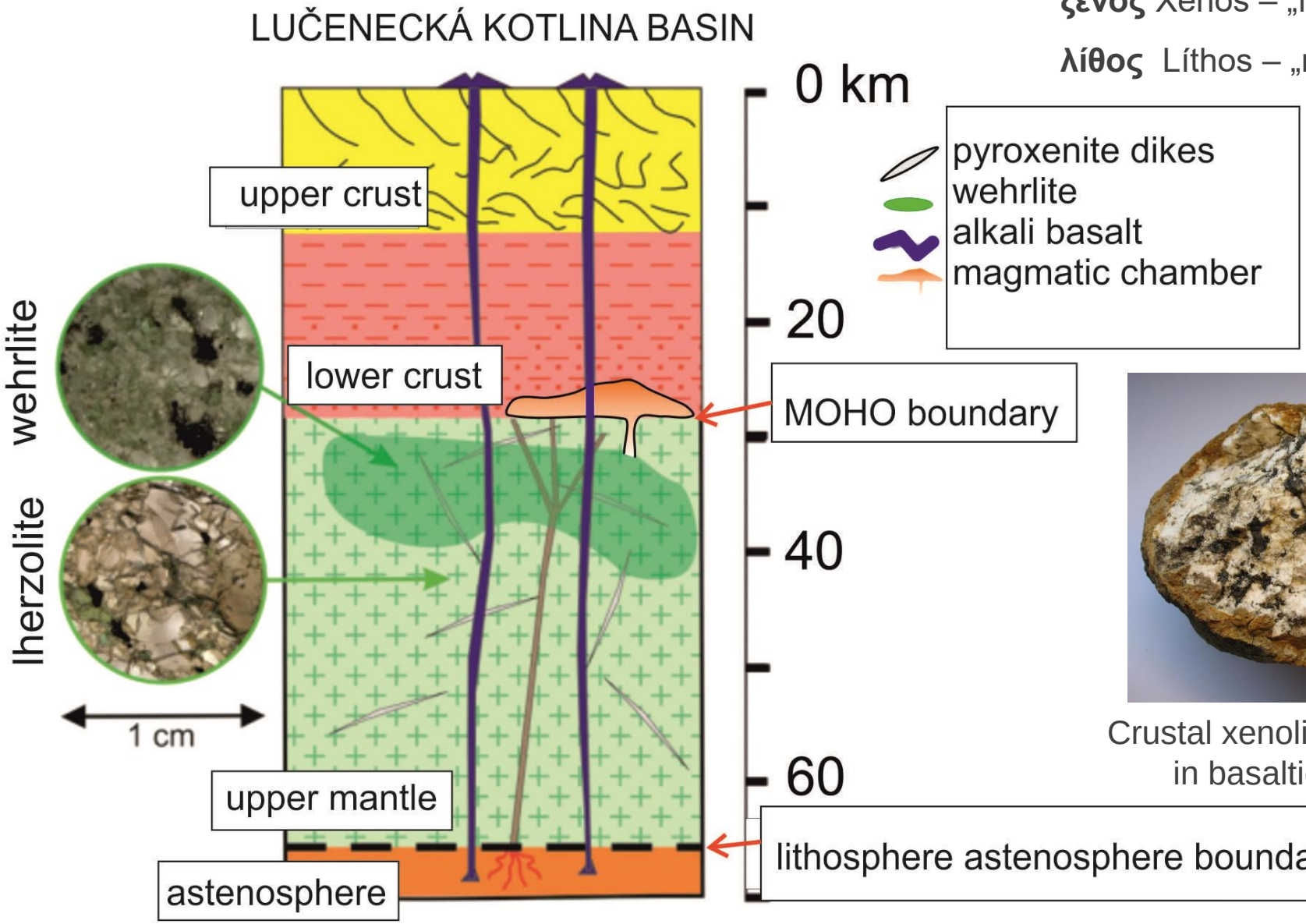
Xenolith – fragment of upper mantle rock– lherzolite (green), transported to the surface in subsolidus state by basalt from the depth greater than 30 km. Mašková locality, Southern Slovakia.

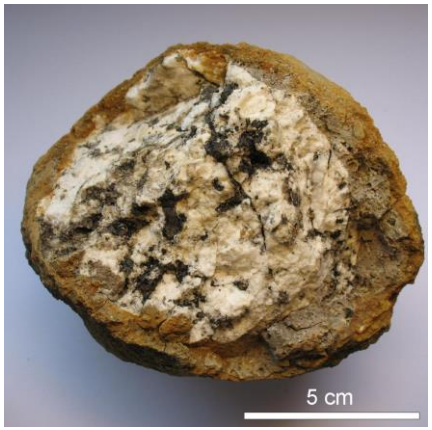
Lithosphere

Xenolith

ξένος Xénos – „foreign“

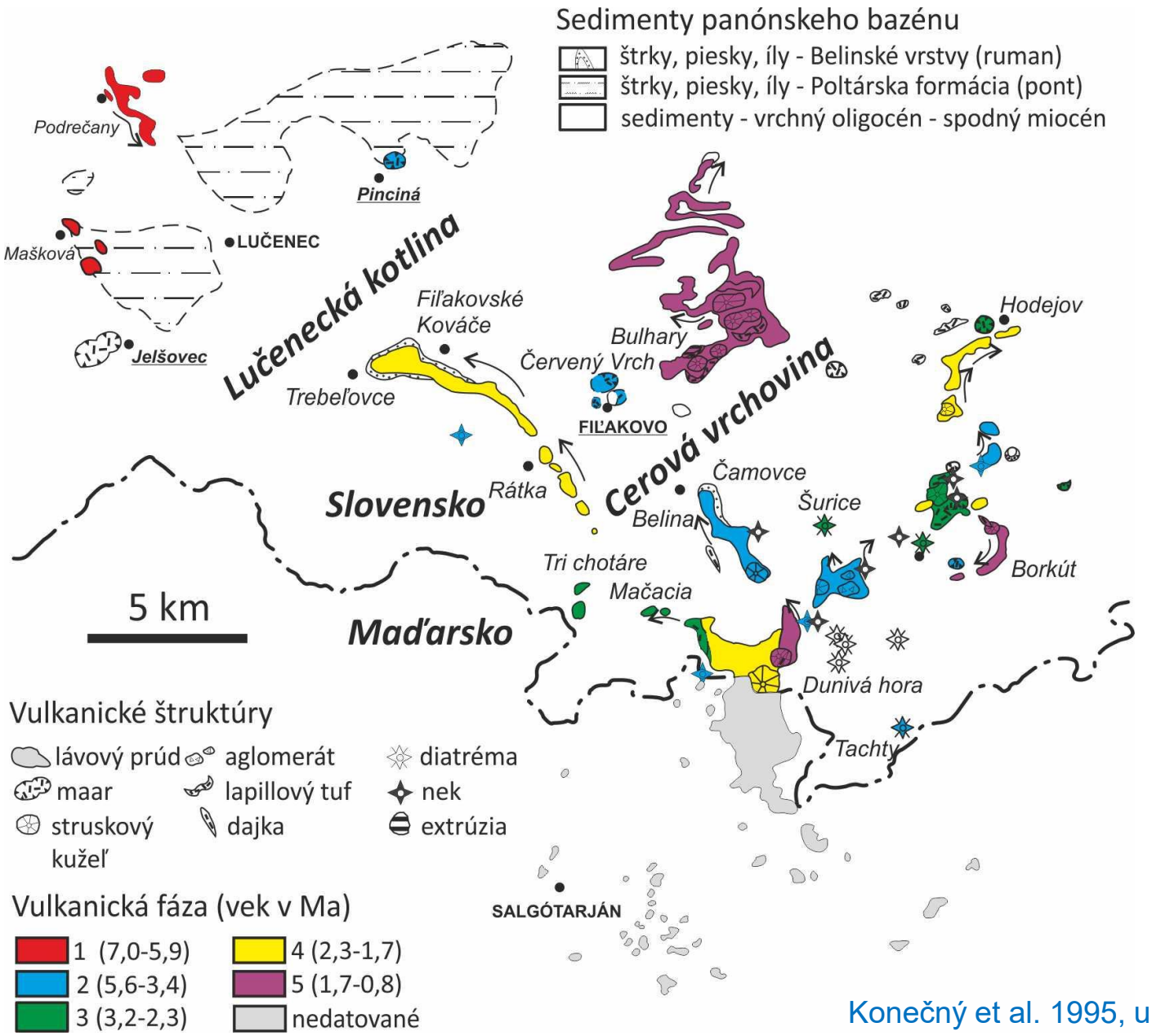
λίθος Líthos – „rock“





Crustal xenolith enclosed in basaltic bomb

Geology

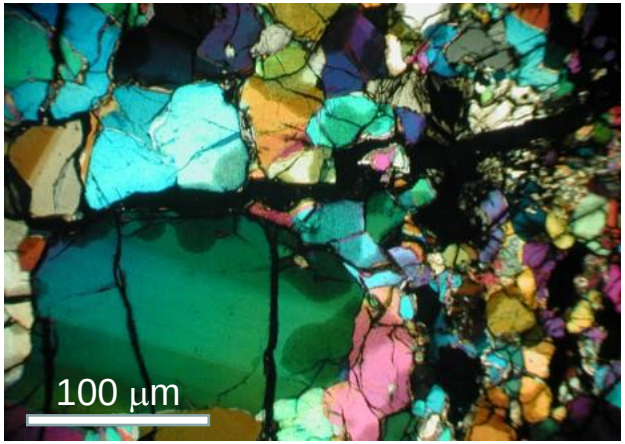


Konečný et al. 1995, upravené

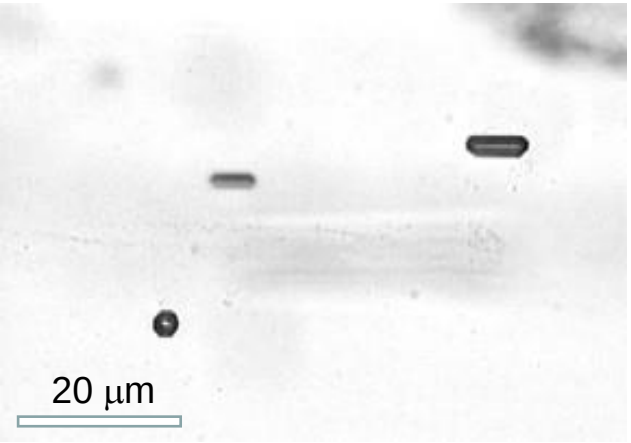
Characteristics of the upper mantle in Pannonian Basin

- composition, thermodynamic conditions and oxidation state

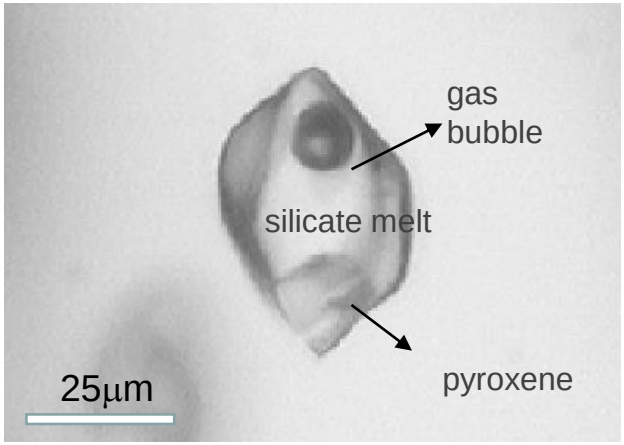
Upper mantle lherzolithic xenolith



Lherzolite xenolith in crossed polars



Primary CO_2-CO-N_2 fluid inclusions in pyroxene, size 5-20 micrometers

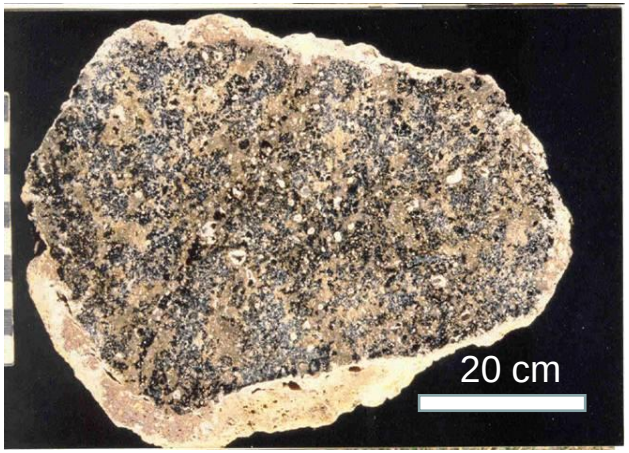


Silicate melt inclusion in olivine, size 50 micrometers

Magmatic reservoirs beneath Lučenec Basin (underplating)

- exotic magmatic xenoliths originating by differentiation from basalt in the lower and middle crust (syenite, gabbro, granite)
- new minerals in Slovakia (chevkinite-Ce, yttrialite, oxykalciopyrochlore, fergusonite)

Felsic xenolith - syenite

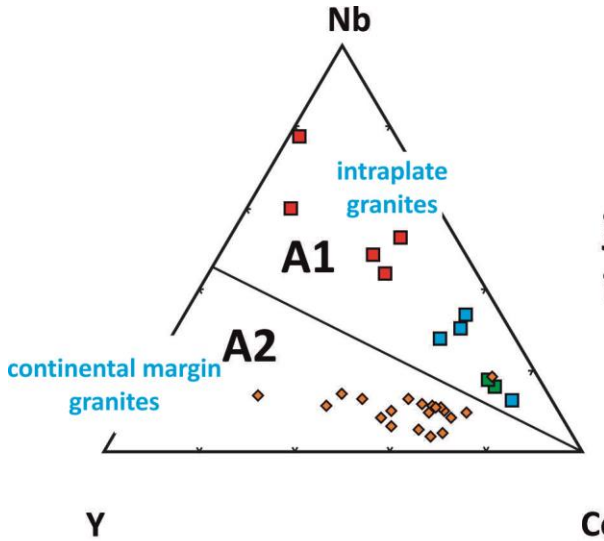


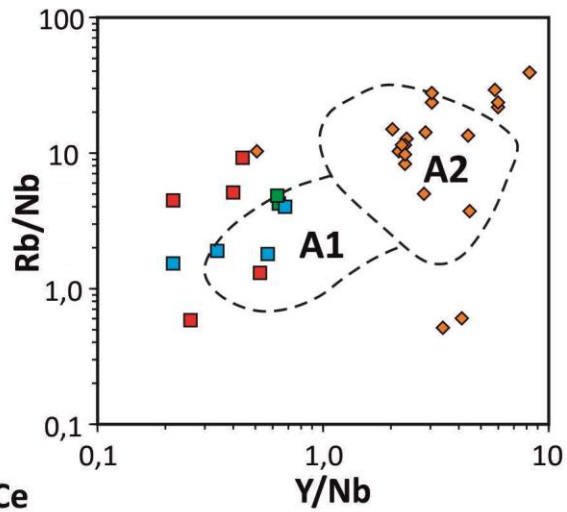
Mafic xenolith - gabbro

Felsic xenolith –
orthopyroxene granite with glass– pincinite.
Type locality Pinciná, Lučenecká kotlina Basin.

Anorogene A_1-type granites

- discovery of acid A_1 type anorogene intrapalate magmatism in Western Carpathians
- potential source of critical elements like REE, Nb and Ta

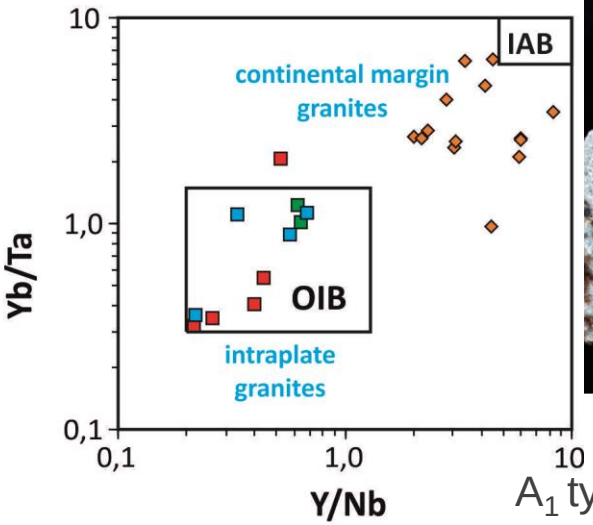




- granite - Čamovce
- granite - Pinciná
- syenite - Pinciná
- A type granites a rhyolites
  Uher a Puskarev (1994)
  Broska a Uher (2001)
  Broska et al. (2004)
  Ondrejka (2004)
  Ondrejka et al. (2007)
  Uher et al. (2009)

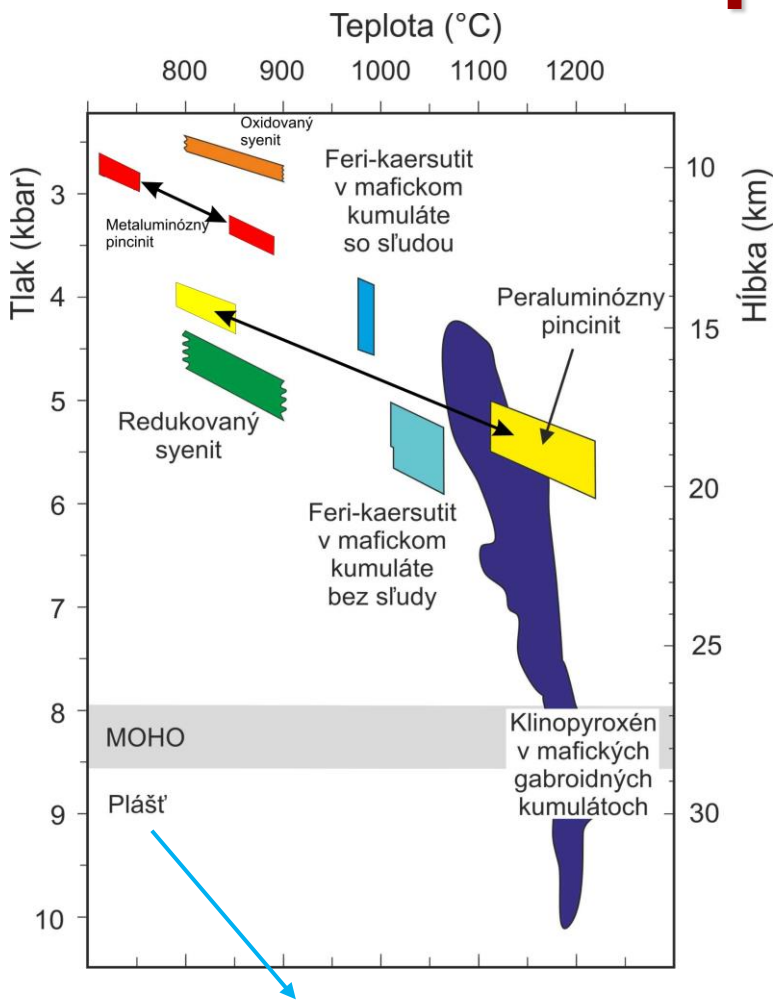
IAB - bazalty ostrovných oblúkov
Island Arc Basalts

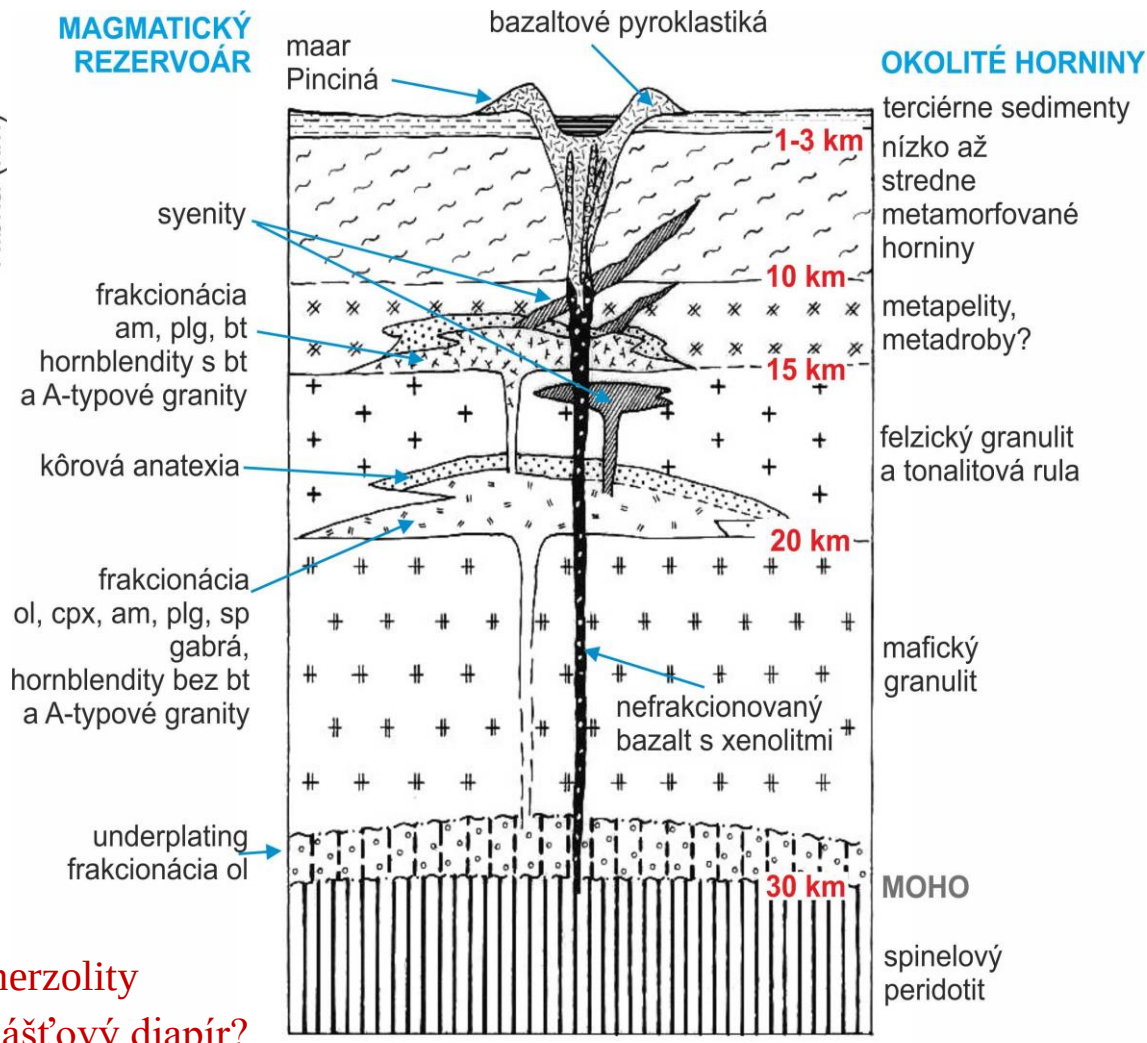
OIB - bazalty oceánskych ostrovov
Ocean Island Basalts



Felsic xenoliths,
A_1 type granites. Čamovce locality,
Cerová vrchovina highland.

Profil Lučenecká kotlina





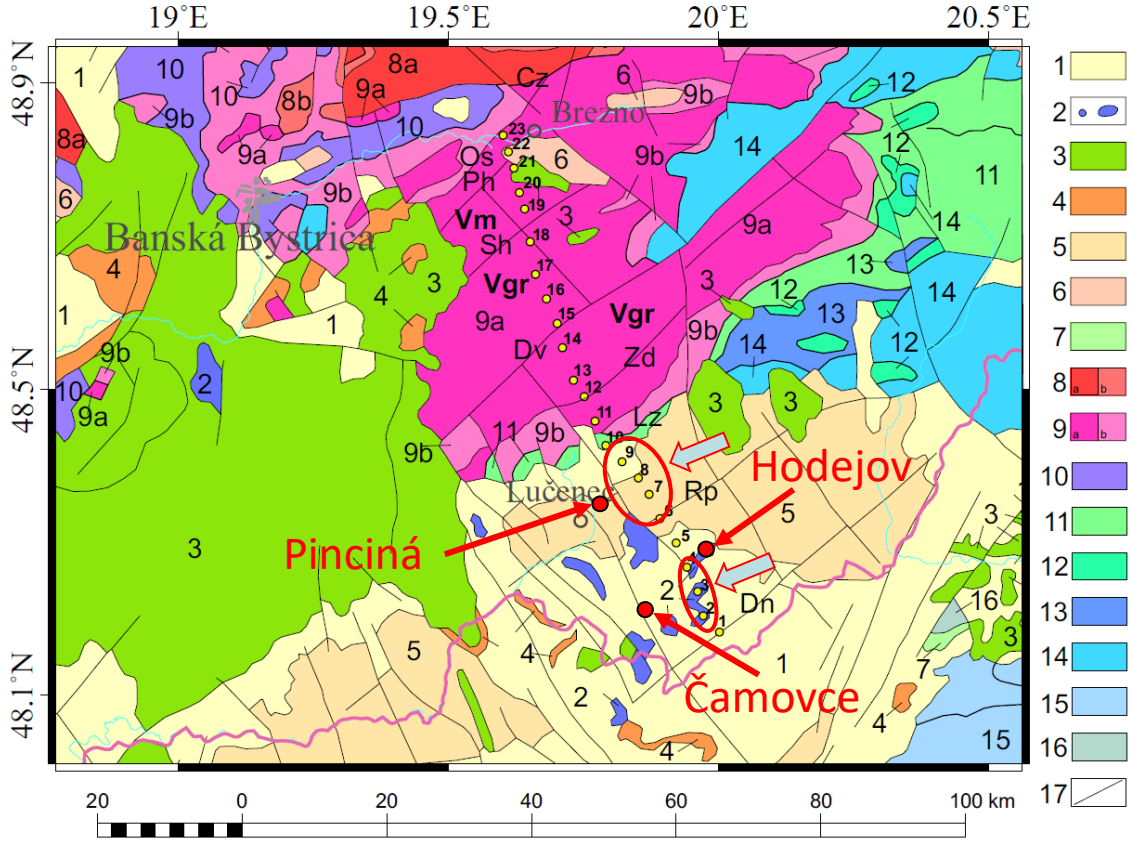
Profil nakreslil Vlastimil Konečný

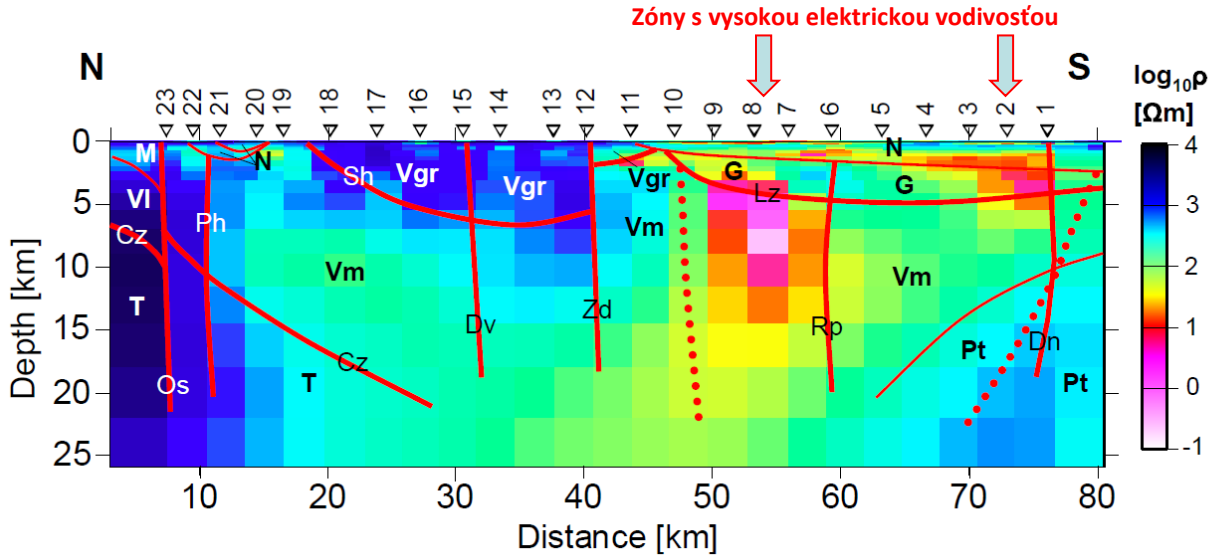
- ultramafické spinelové peridotity - lherzolity
- rôzny stupeň deformácie - lokálny plášťový diapír?
- slabá metasomatóza, teplota 920-1060 °C
- oxidačný stav priemerne -0.2 logfO_2 FMQ, hĺbka >28 km
- fluidá s prevahou $CO_2(\pm CO \pm N_2)$

Profil 2T

Širokopásmová magnetotelurická sondáž

Bezák et al. (2014): Geological interpretation of magnetotelluric sounding in the southern part of seismic profile 2T (Central Slovakia). Contrib. Geophys. Geodesy 44, 329-339

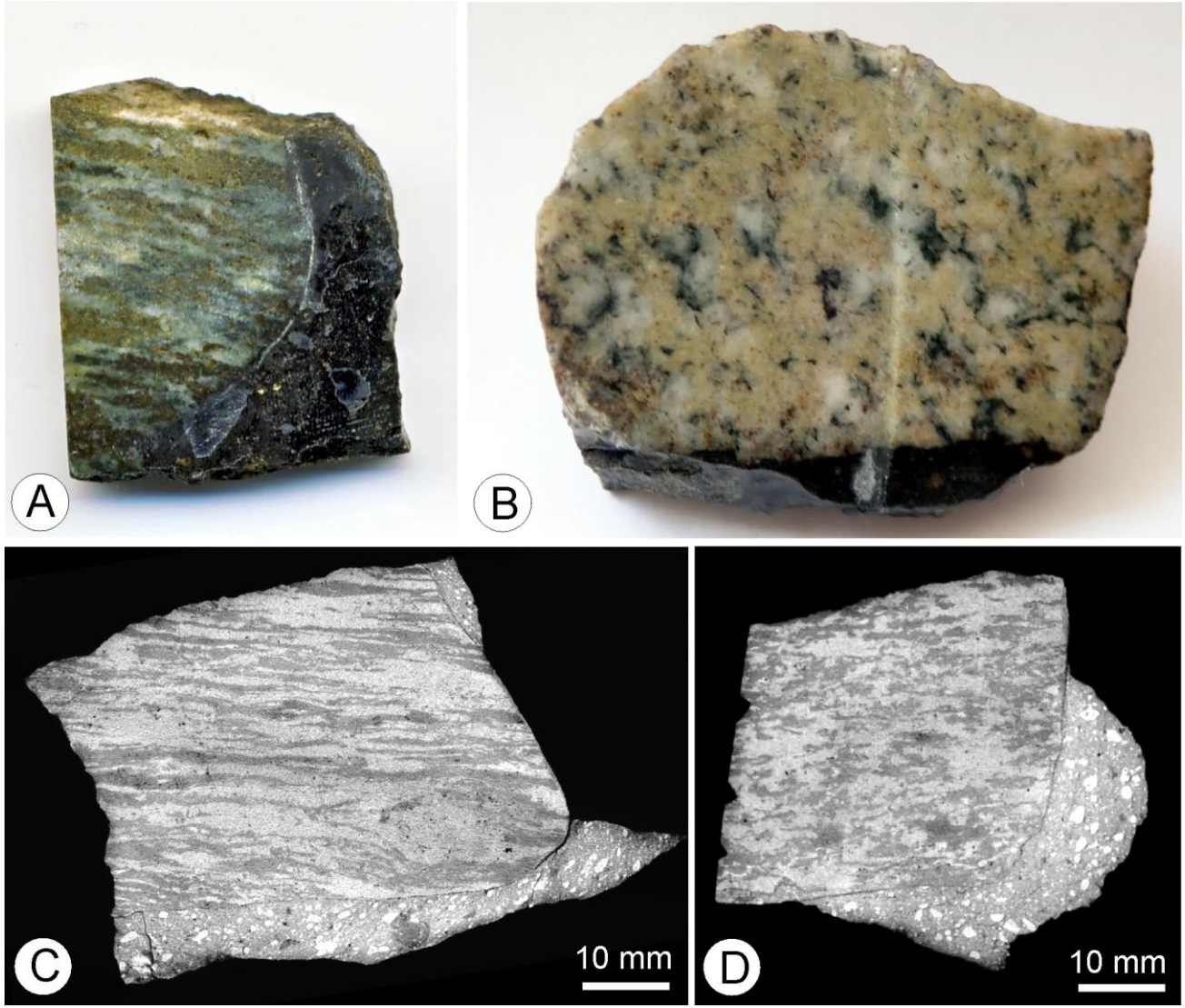




Calc – silicate skarnoid xenoliths

Banded texture with two layers:

* olivine + diopside
* anorthite



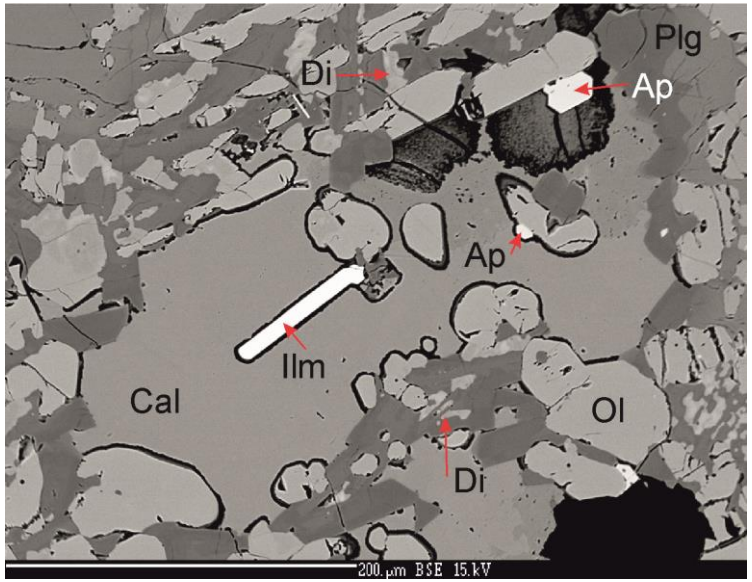
Skarnoid xenoliths. Čamovce locality, Cerová vrchovina Highland.

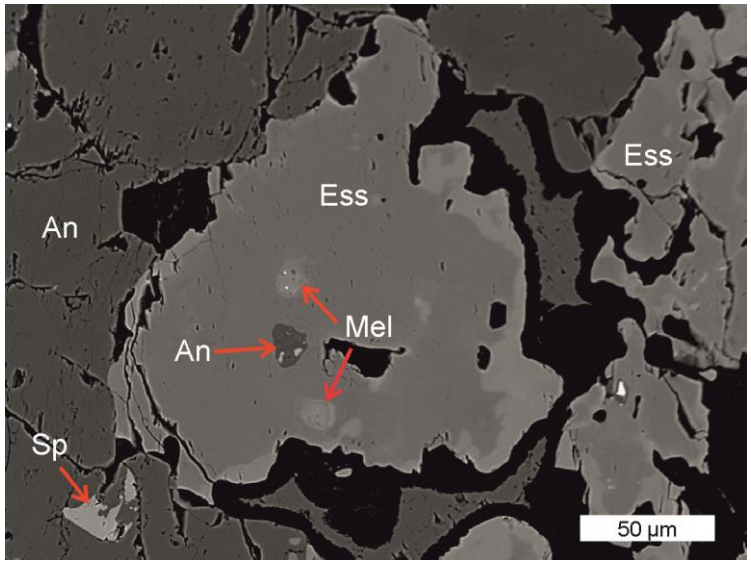
Mineral assemblages of skarnoid xenoliths

1. plagioclase (An) – pyroxene (diposide-augite Di) – older, pristine

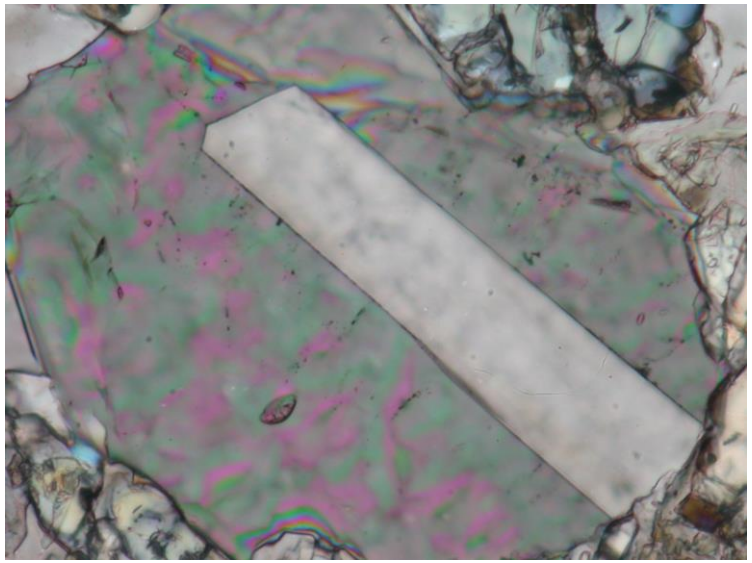
2. olivine (Ol) – calcite (Cal) ± ilmenite (Ilm)– superimposed, product of interaction between carbonatitic melt with diopside

3. corundum – spinel – K-feldspar – foids – product of interaction with host basalt



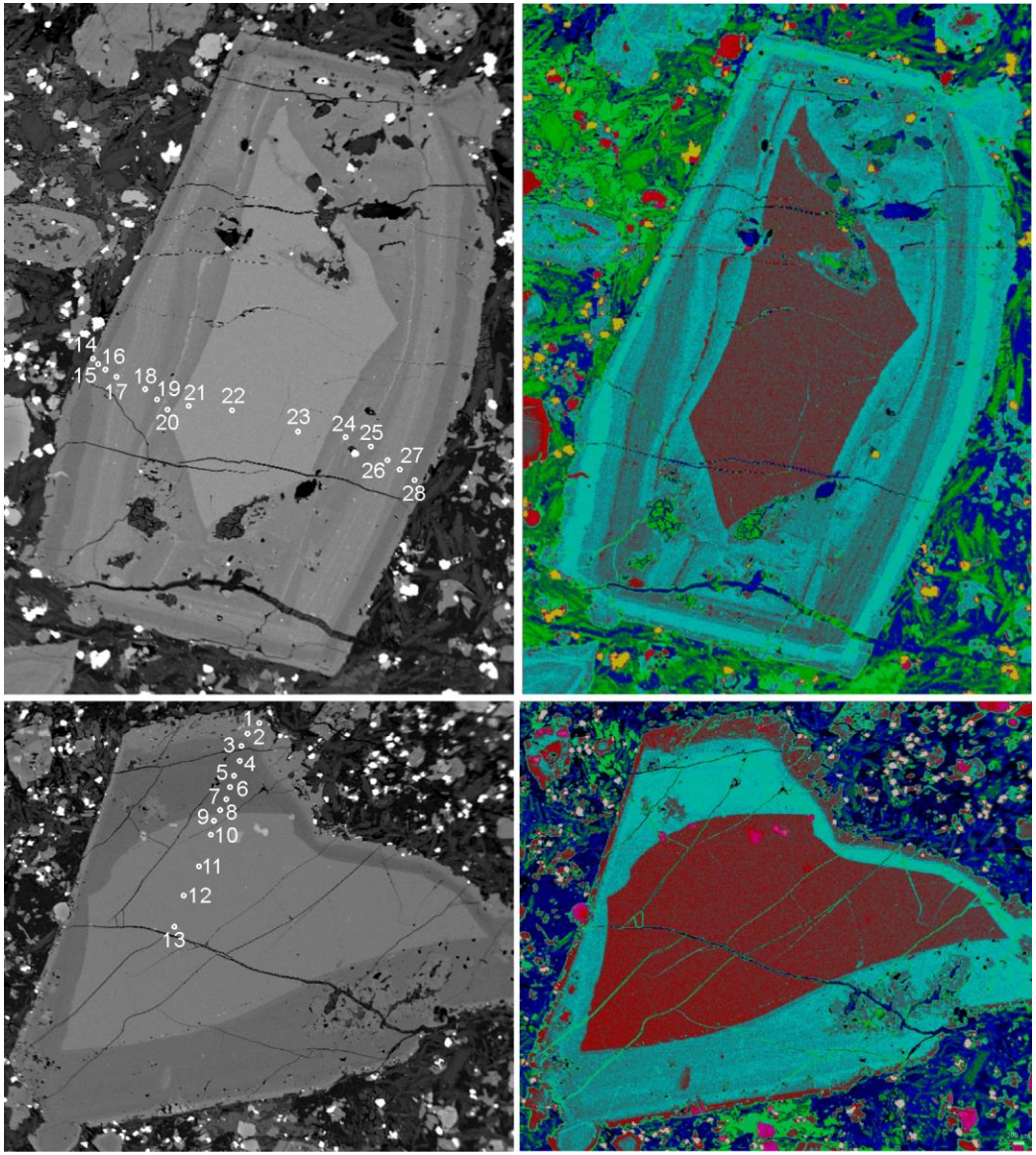


Inclusions of melilite in esseneite. Sample CA-14. Čamovce locality.

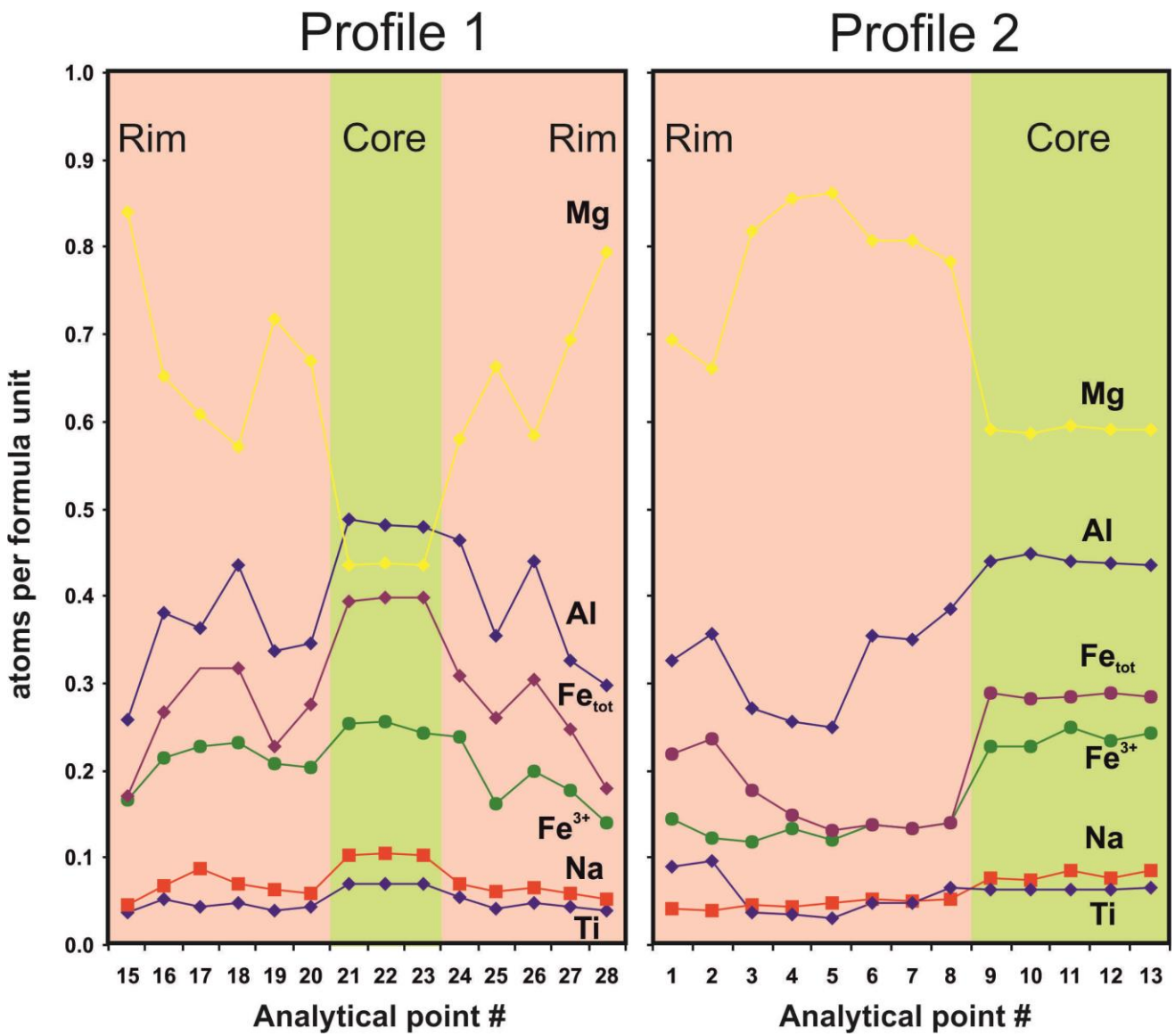


Aragonite crystal in calcite matrix. Sample CAM-13, Čamovce locality

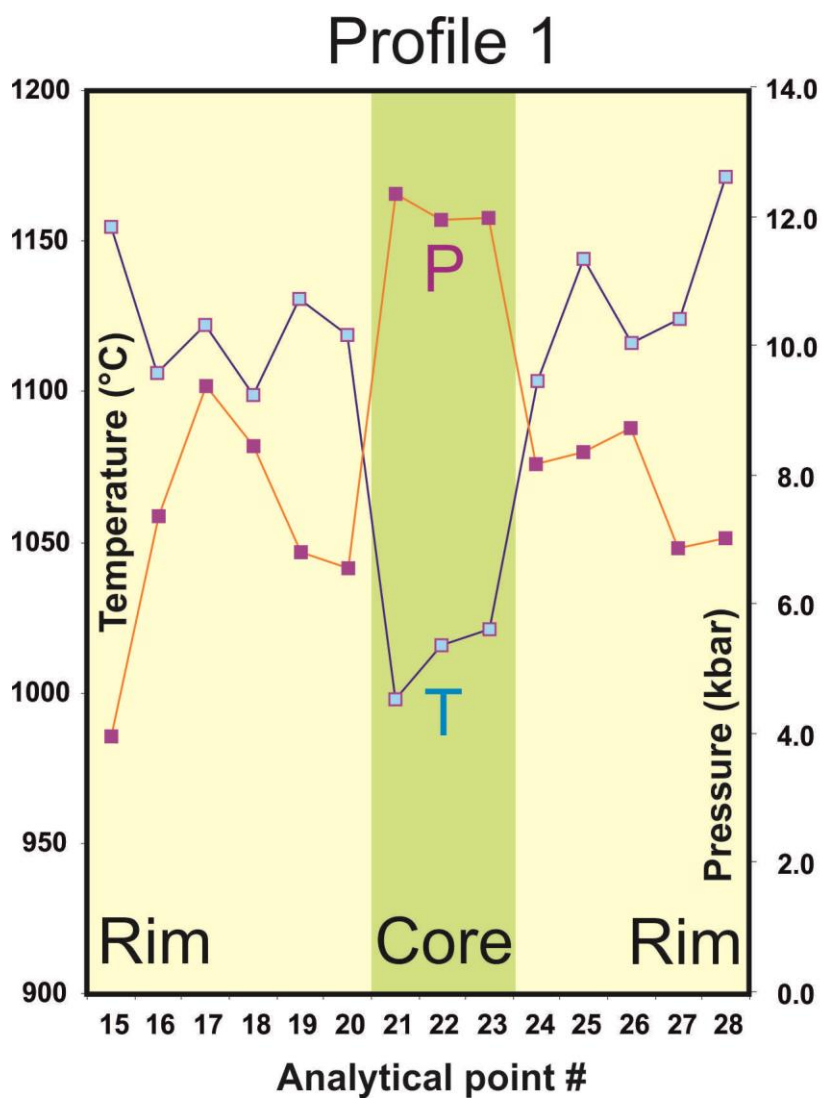
Megacrystals and phenocrystals

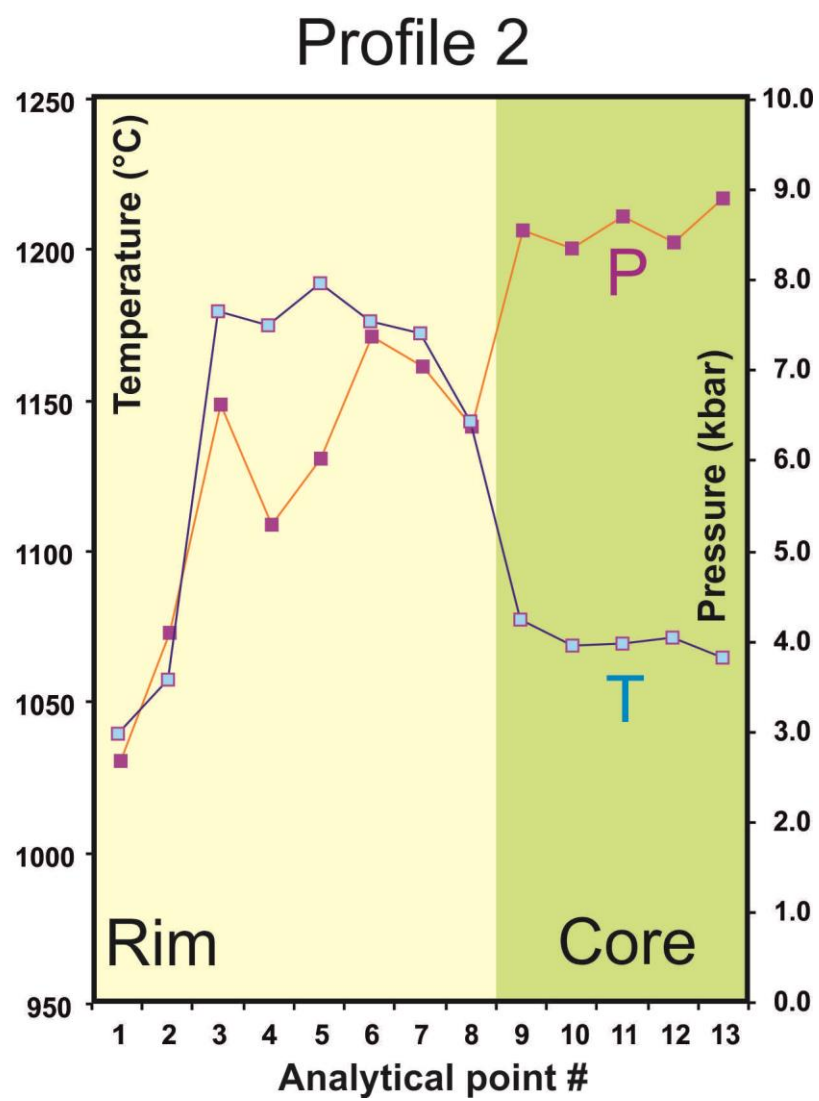


Megacrystals and phenocrystals

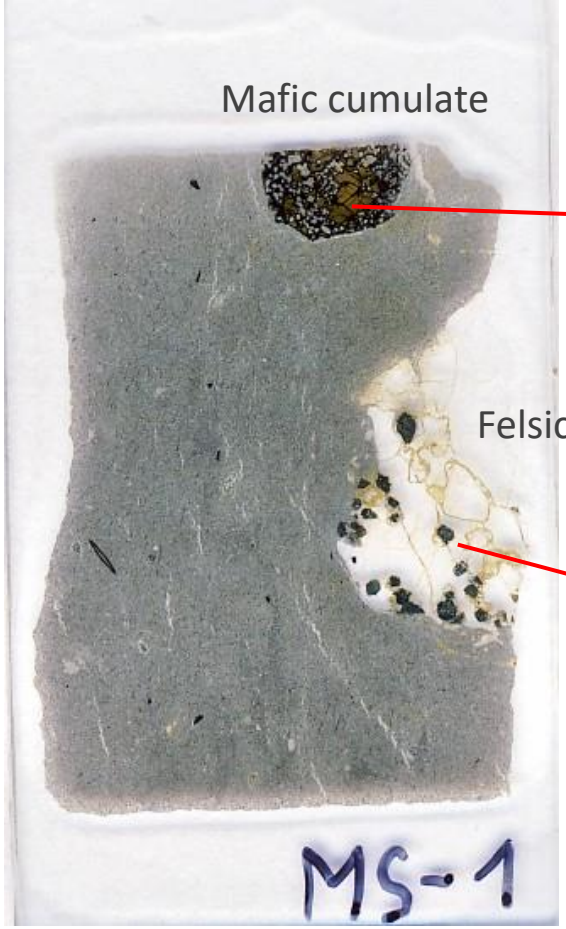


Megacrystals and phenocrystals

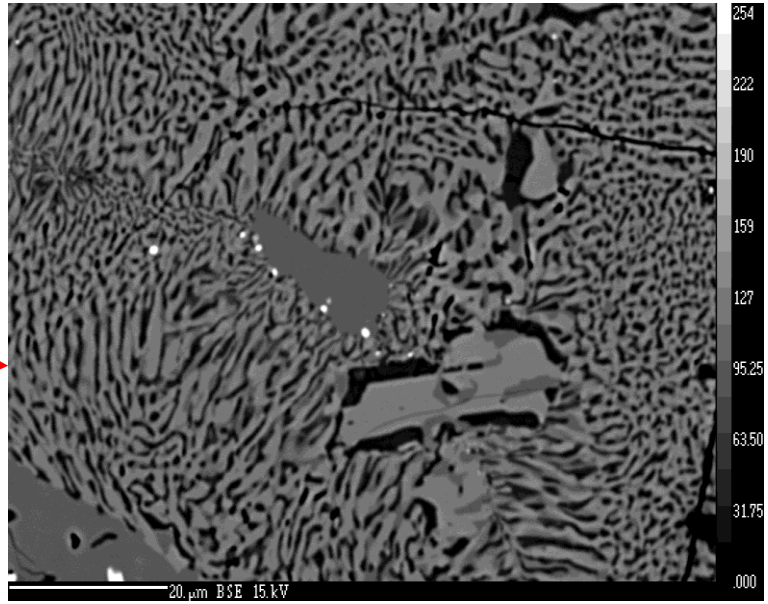




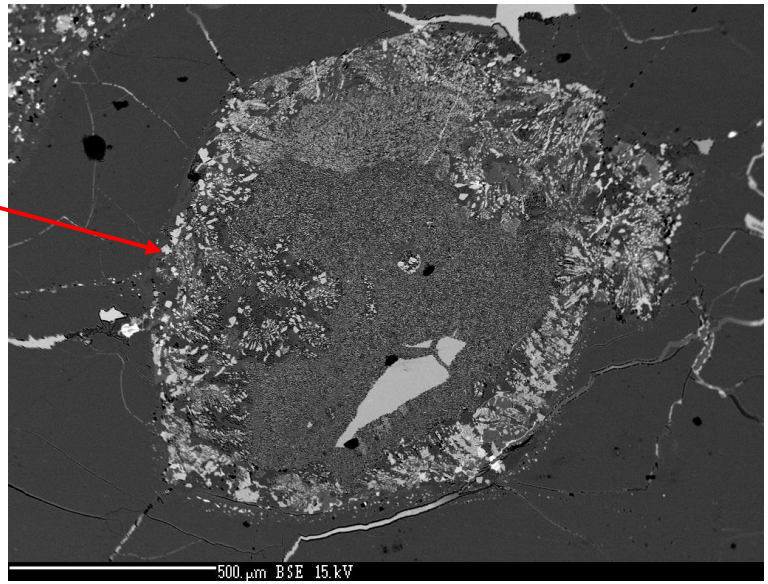
Symplectites in granulite and mafic cumulate xenoliths



Resorbed kaersutite - rhoenite



Resorbed garnet – two generations of symplectites



Two types of xenoliths in basalt.

Carbonatites in China (Feng Zhen, Miaoya)

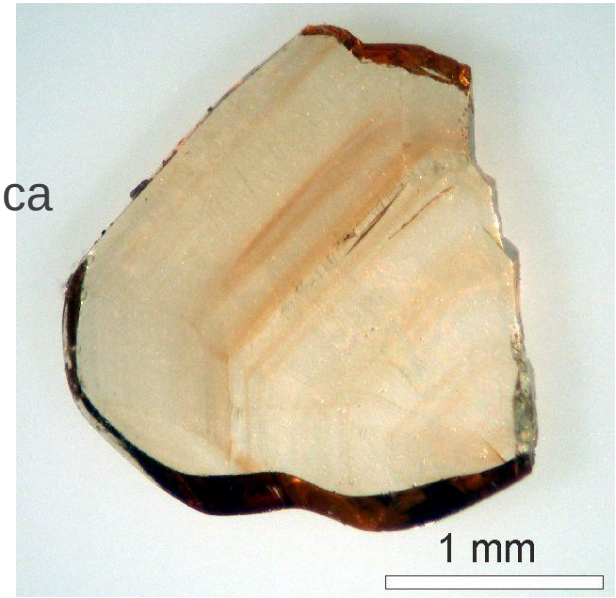
Contact of syenite and carbonatite

VEGA grant 1/0013/22: „Mobility and accumulation of critical elements during formation and alteration of orogenic carbonatites“. 2022-2025

Carbonatite with pyroxene

Cooperation

Universität Wien, Department für Lithosphärenforschung, Wien, Austria
University of Waikato, Department of Earth and Ocean Sciences, Waikato, New Zeland
Université Henri Poincaré, Vandœuvre-lès-Nancy, France
Université Blaise Pascal, Clermont-Ferrand, France
Institute for Synchrotron Radiation, Forschungszentrum Karlsruhe, Eggenstein-Leopoldshafen, Germany
GFZ Helmholtz-Zentrum, Potsdam, Germany
Institute of Geochemistry, Georg-August University, Göttingen, Germany
Institute of Mineralogy and Geochem., Albert-Ludwig University, Freiburg, Germany
Geoafrica Prospecting Services, Windhoek, Namibia
Polish Academy of Sciences, Warszawa, Poland
State Geological Institute of Dionýz Štúr, Bratislava
Earth Science Institute, SAS, Bratislava, Banská Bystrica
Slovak University of Technology, Bratislava



Fragment of larger megacrystal of zircon, used for dating, Hajnáčka – Kostná dolina valley, Southern Slovakia

Thank you for your attention

Diatreme Hajnáčka with xenoliths and megacrystals, Southern Slovakia.