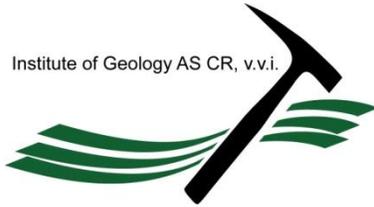


# Petrogenesis and Lu–Hf dating of (ultra)mafic rocks from the Kutná Hora Crystalline Complex: implications for the Devonian evolution of the Bohemian Massif



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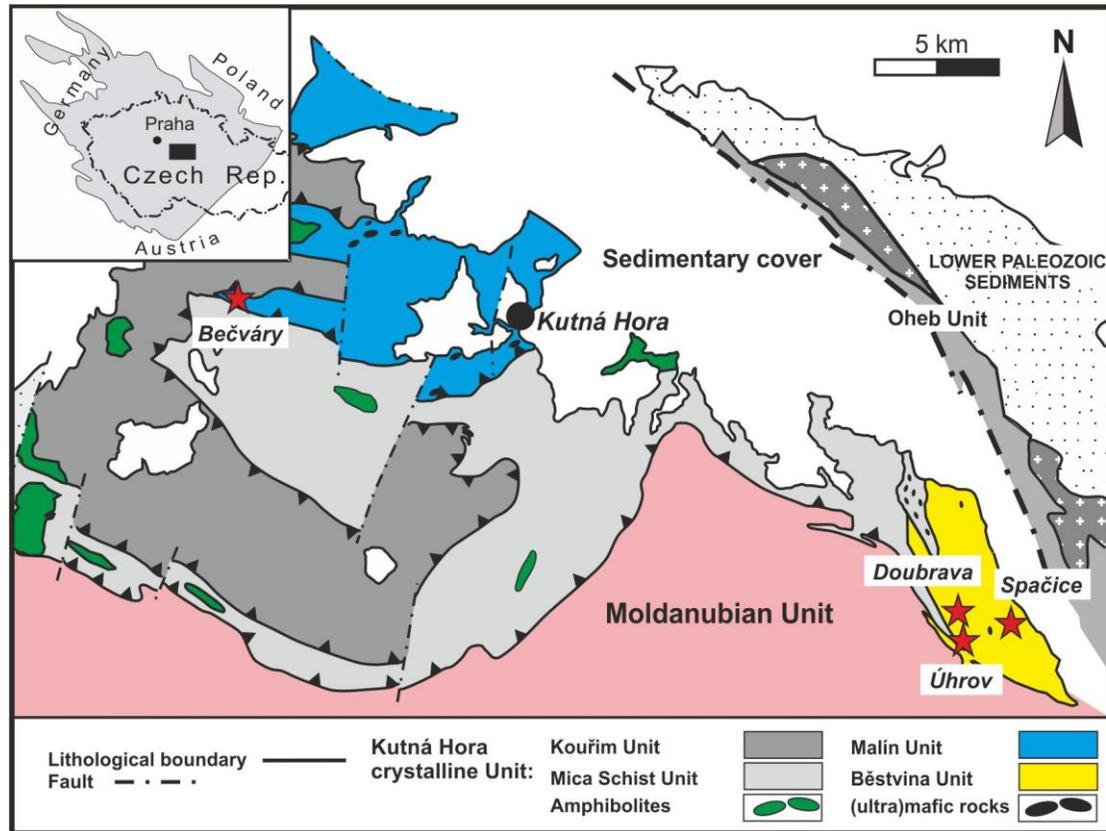
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# Kutná Hora Crystalline Complex

## Bohemian Massif, eastern part of the European Variscan Belt



UHP terrane

fragments/boudins of garnet peridotites, pyroxenites, eclogites

Medaris et al. 2005, Faryad 2009, Faryad et al. 2009

UHPM rocks (diamond, coesite, Perraki – Faryad 2014)

= deep subduction

geochronological data 380-360 and 340-330

for both mantle and crustal rocks

= complete geochronological record



key area for studying crust-mantle interaction  
and constraining geodynamic evolution of the Bohemian Massif

- new Lu–Hf geochronological data for (ultra)mafic rocks interpreted based on a detailed study of petrography, multiphase solid inclusions in garnet, and mineral trace element composition and zoning
- whole-rock major and trace element compositions and Sr–Nd–Hf–Os isotopic systematics = extent, environment and timing of depletion and enrichment/refertilization of the KHCC peridotites

# Studied samples: mineral assemblages and modal composition

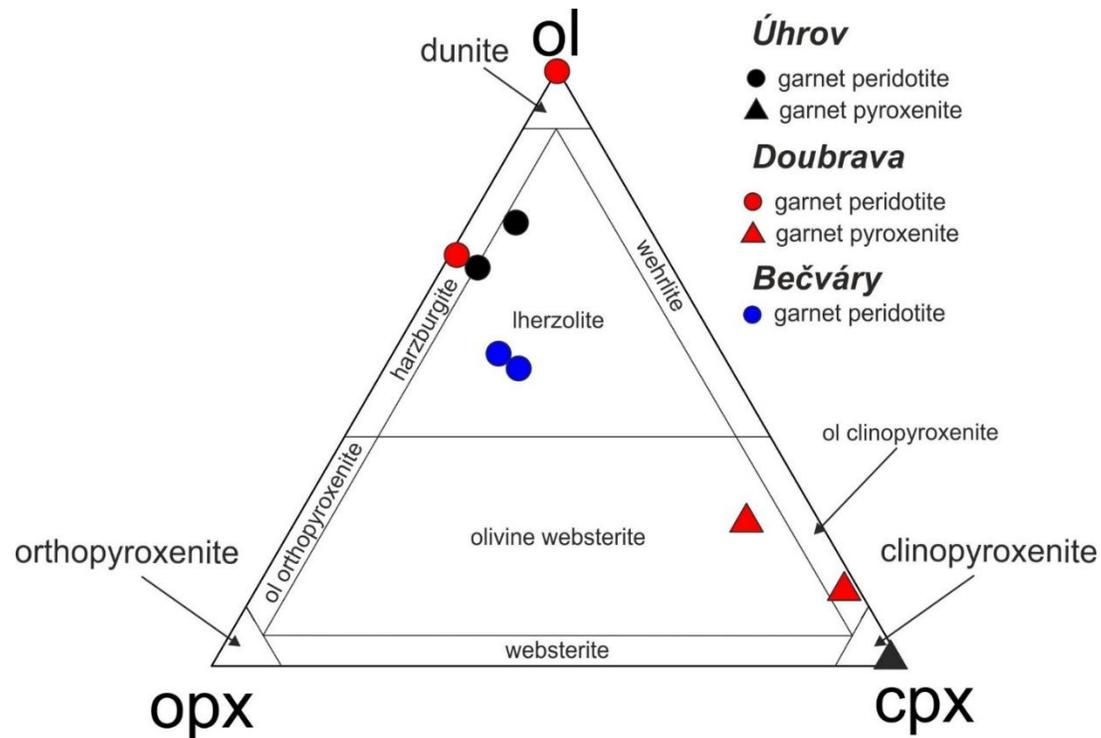


Table 1: Summary of the studied samples from the Kutná Hora Crystalline Complex and their modal composition

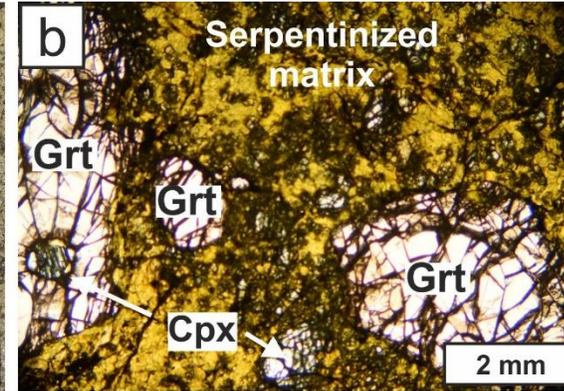
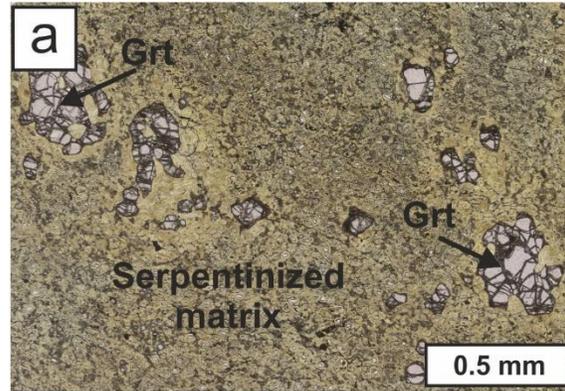
Sample	Locality	Lithology	Bulk modal composition (wt. %)			
			Ol	Opx	Cpx	Grt
<b>Peridotites</b>						
Uhr17a	Úhrov	Grt Lherz	68	17	6	8
Uhr17b	Úhrov	Grt Lherz	62	26	5	7
Doub4	Doubrava	Spl±Grt Dun	>95	<5	<5	<5
Doub5	Doubrava	Spl-Grt Harz	69	30	1	<1
Bec1	Bečváry	Grt Lherz	42	26	12	19
Bec2	Bečváry	Grt Lherz	36	22	14	28
<b>Pyroxenites</b>						
Bulk modal composition (wt. %)						
Ol Opx Cpx Grt						
Uhr17c	Úhrov	Grt Clinopyroxenite		<1	56	54
Doub2	Doubrava	Ol-Grt Webs	23	10	62	5
Doub2b	Doubrava	Ol-Grt Clinopyroxenite	12	2	80	6
<b>Eclogites</b>						
Bulk modal composition (wt. %)						
Cpx Grt Pl Qz						
Urh_E	Úhrov	Ky Eclogite	15	37	16	32
Doub7	Doubrava	Eclogite	36	59	5	
Sp1f	Spačice	Ky Eclogite	60	25	15	
Sp1-16	Spačice	Ky Eclogite	7	53	19	21

Ol - olivine, Opx - orthopyroxene, Cpx - clinopyroxene, Grt - garnet, Pl - plagioclase, Spl - spinel

Qz - quartz, Ky - kyanite, lherz - Lherzolite, Harz - harzburgite, Dun - dunite, Webst - websterite

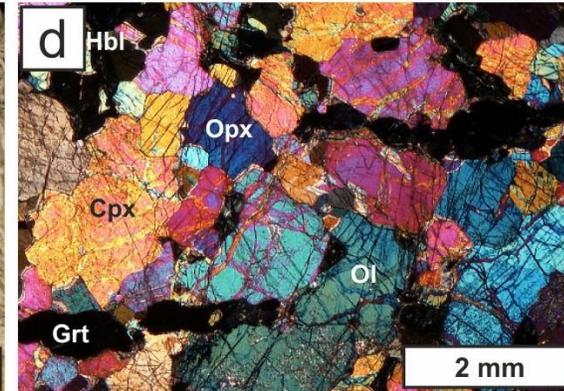
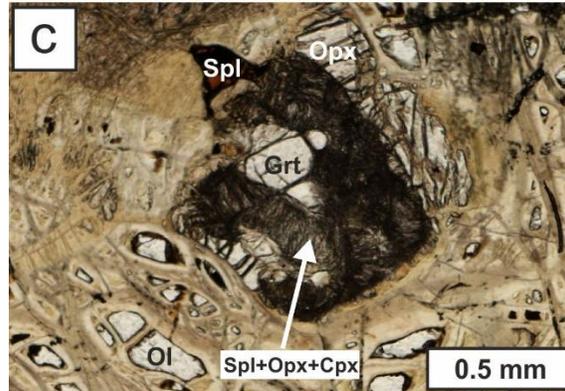
# Studied samples: textures and major phases

garnet lherzolite  
Úhrov



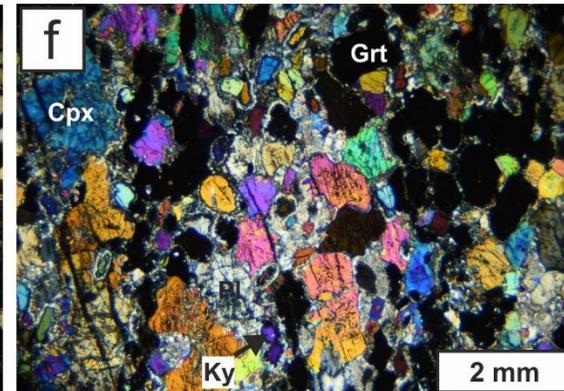
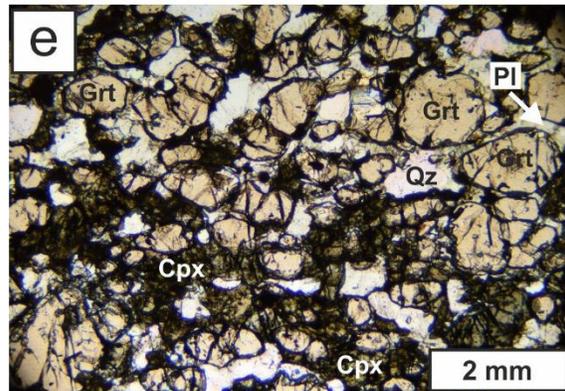
garnet lherzolite  
Bečváry

spinel-garnet harzburgite  
Doubrava



olivine-garnet websterite  
Doubrava

kyanite eclogite  
Úhrov



kyanite eclogite  
Spačice

# Petrogenesis of peridotite-pyroxenite assemblages and Lu-Hf dating

**garnet lherzolite, Úhrov**      depleted oceanic asthenospheric mantle

**395 ± 23 Ma** Grt-Opx+Cpx-Cpx-WR

low Cpx abundances (5–6 wt. % and ~1 wt. %), low Al<sub>2</sub>O<sub>3</sub> and CaO  
10 - 20 % partial melting  
LREE-depleted patterns

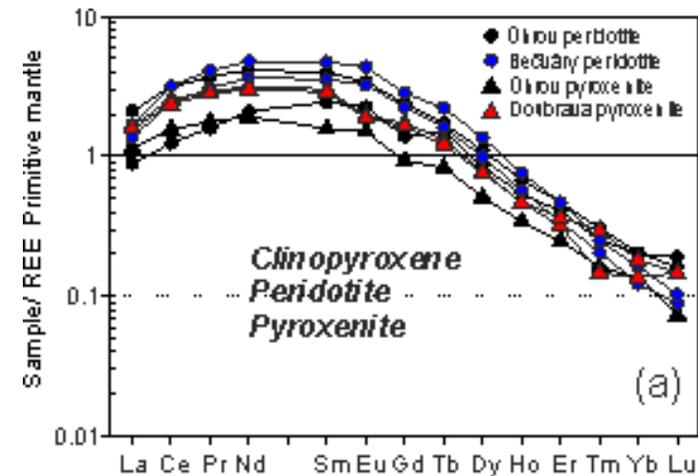
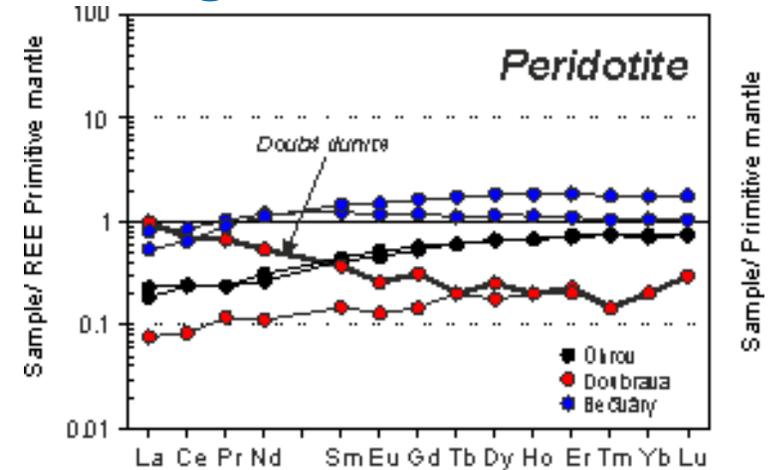
**garnet lherzolite, Bečváry**      extensive refertilization by basaltic melts associated with Grt±Cpx precipitation

up to 28 % of garnet – high Al<sub>2</sub>O<sub>3</sub>, low Ol content , Cpx in garnet  
low Mg #

low Os and high <sup>187</sup>Re/<sup>188</sup>Os

highly to mildly radiogenic Sr–Nd–Hf–Os isotopic compositions  
+ negative HFSE anomalies in clinopyroxene

indicate only a very small contribution of recycled crustal component



multiphase solid inclusions (MSI) trapped in garnet, dominated by Ti and Fe-Ti oxides (rutile, ilmenite), represent relics of Ti-rich low-degree basaltic partial melt

minor hornblende/phlogopite and carbonate reflect mantle metasomatism by H<sub>2</sub>O±CO<sub>2</sub>-bearing fluids

# Petrogenesis of peridotite-pyroxenite assemblages and Lu-Hf dating

**Doubrava peridotites** interaction between depleted protolith and SiO<sub>2</sub>-undersaturated infiltrating basaltic melt with small proportion of recycled crust (~5 % when subducted oceanic crust is considered)

marked petrological variability = harzburgite to composite dunite-wehrlite/olivine-bearing pyroxenite

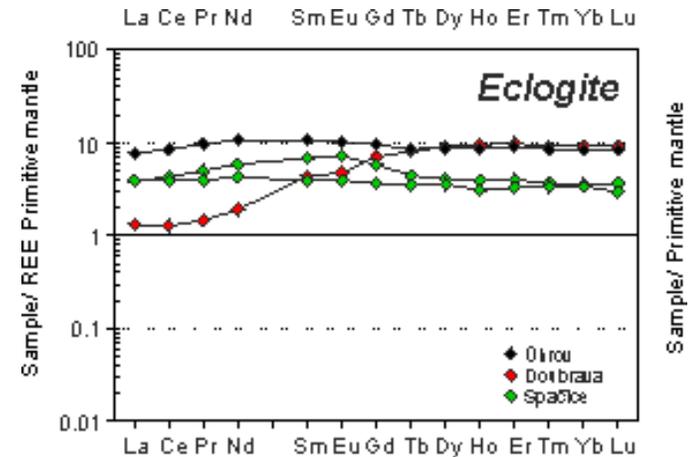
LREE and Fe enrichment of dunite

radiogenic present-day <sup>187</sup>Os/<sup>188</sup>Os signature and the most pronounced HFSE negative anomalies in pyroxenites

**KHCC eclogites** **350 - 330 Ma** Grt-Cpx-WR

diverse origins

products of high-pressure crystal accumulation from mantle-derived basaltic melts, or a fragment of MORB-like gabbroic cumulate and crustal-derived material both metamorphosed at HT-HP conditions



# Proposed refined geodynamic model

~ 400 Ma subduction of the oceanic crust and associated oceanic asthenospheric mantle beneath the Teplá–Barrandian related to closure of the Saxothuringian ocean between Gondwana-derived microcontinents

overlying lithospheric mantle wedge was refertilized by fluids/melts

~ 370–360 Ma? continental subduction of the Saxothuringian crust accompanied by the break-off of the eclogitized oceanic crust facilitating incorporation of the upwelling asthenospheric mantle into the Moldanubian lithospheric mantle wedge

~ 350–330 Ma collision and coeval exhumation of mantle and crustal rocks might be associated with mixing/mingling of crustal-derived melts and mafic lithologies producing the observed geochemical and geochronological signatures

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