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Supra-subduction mantle pyroxenites in an infant subduction system: the New Caledonia ophiolite record.

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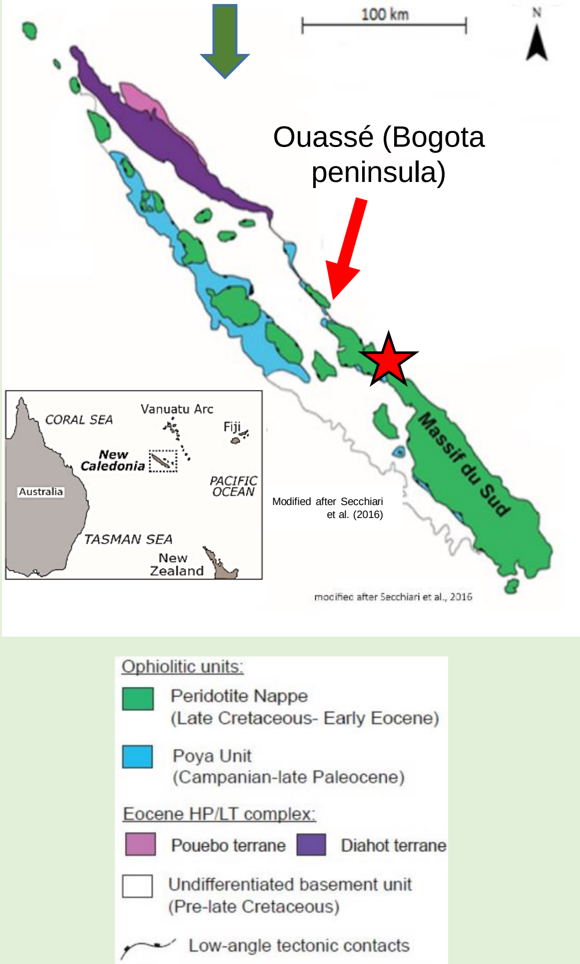
GEOLOGICAL BACKGROUND

New Caledonia is a NW-SE elongated island located in the SW Pacific region between the New Hebrides Arc (Vanuatu) and the eastern margin of Australia.



From: Secchiari et al., (2020) modified

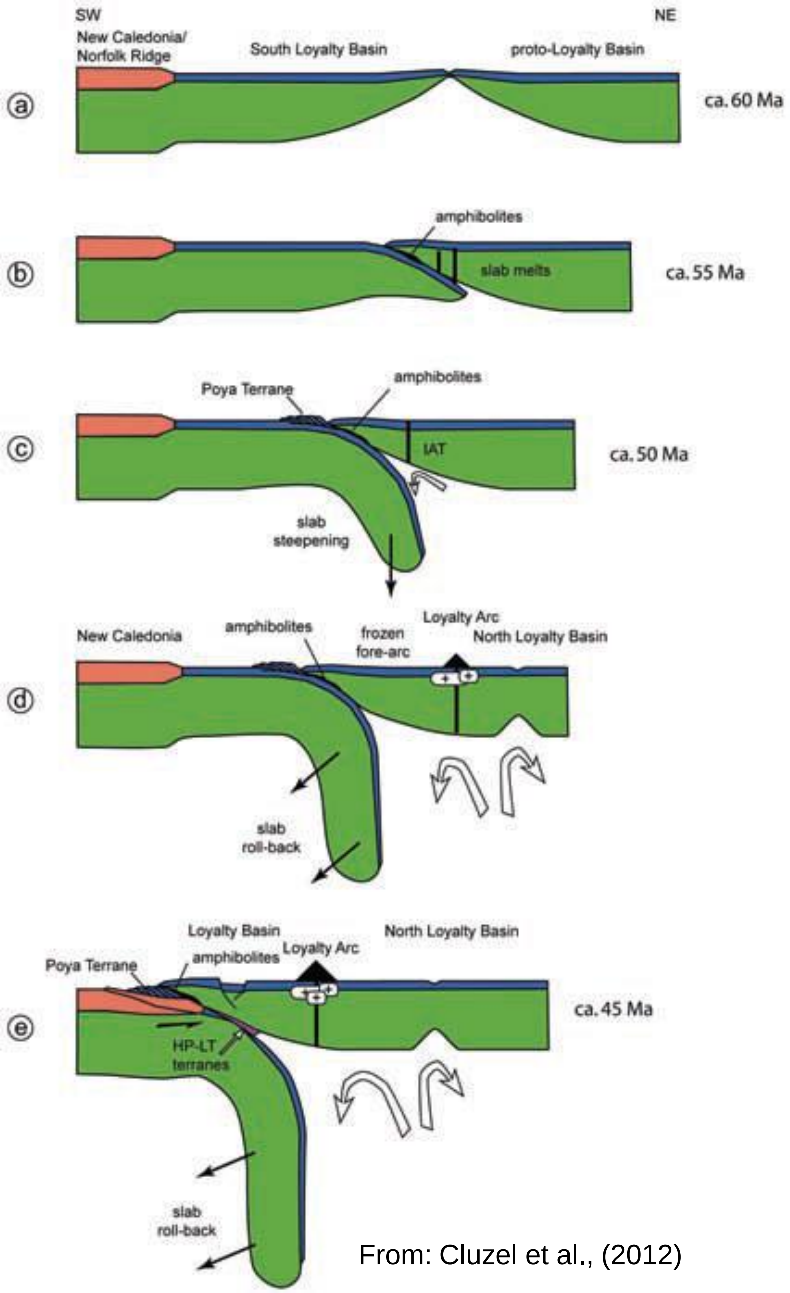
The main island of New Caledonia is composed of an assemblage of volcanic, sedimentary and metamorphic terranes ranging in age from Permian to Miocene which were assembled during two main tectonic events (see Cluzel et al., 2012):

- Permian to Early Cretaceous west-dipping subduction, related to the east Gondwana active margin
- Eocene north-east dipping subduction that eventually resulted in obduction of the New Caledonia ophiolite ("Peridotite Nappe", auct.)

The ophiolite is dominated by a **harzburgite-dunite sequence**, locally overlain by km-scale lenses of mafic and ultramafic intrusives formed in a **nascent arc setting**. A maximum thickness of ~ 2500 m is observed in the S part of the island (Massif du Sud).

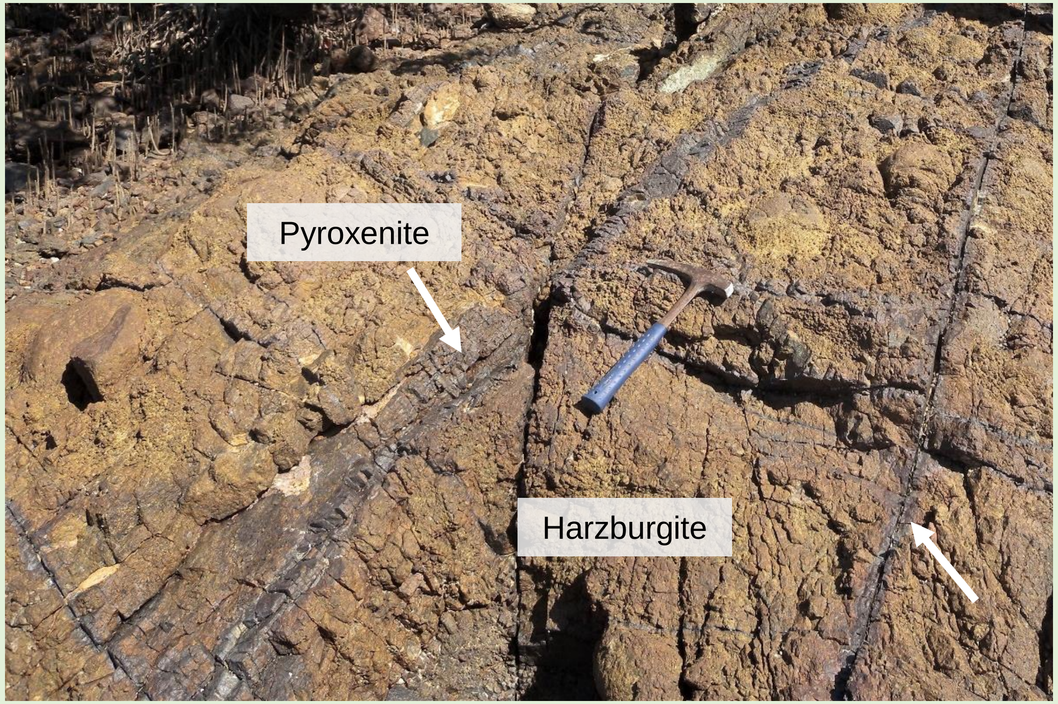
The **harzburgites** are cpx-free, **highly refractory** residual rocks that register a multi-phase evolution, including fluid-assisted melting in a forearc environment and contamination by fluid- and melt inputs triggered by Eocene subduction (Marchesi et al., 2009; Pirard et al., 2013; Secchiari et al., 2020).

Felsic pre-obduction dikes derived from slab melts (Cluzel et al., 2006) are widespread in the harzburgites, whereas pyroxenitic rocks intruding the harzburgites are only known in the area of this study (Bogota peninsula), along the northern coast of the island



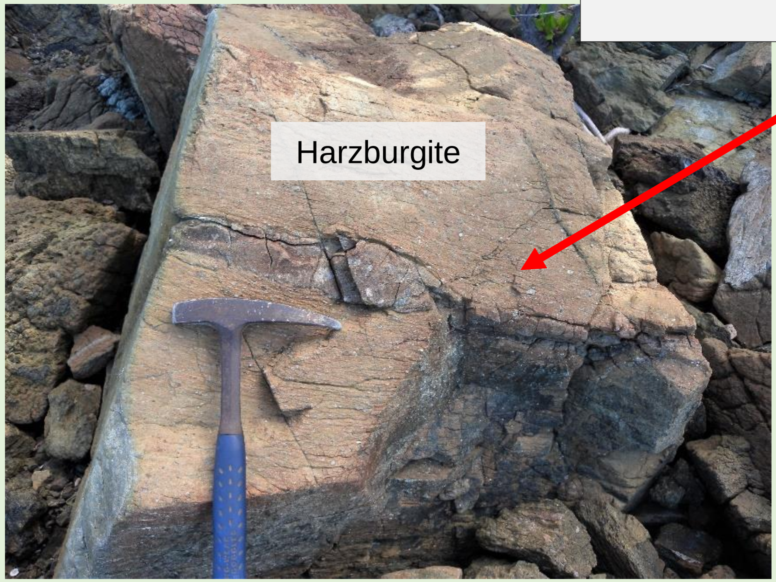
From: Cluzel et al., (2012)

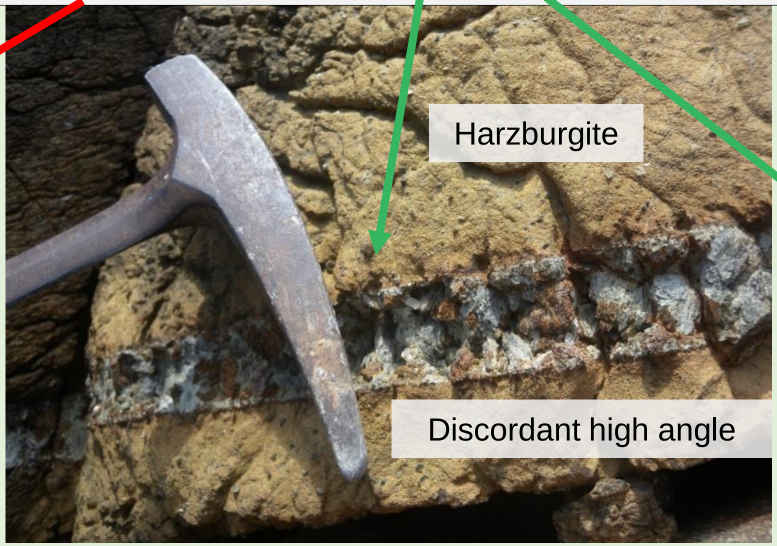
OUASSÉ PYROXENITES: FIELD WORK

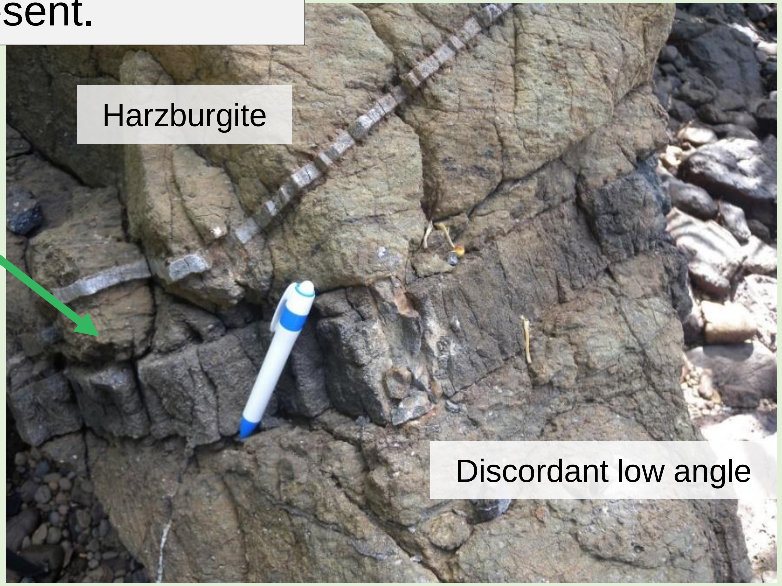


Pyroxenites occur as 5-15 cm thick layers enclosed in refractory mylonitic harzburgites.

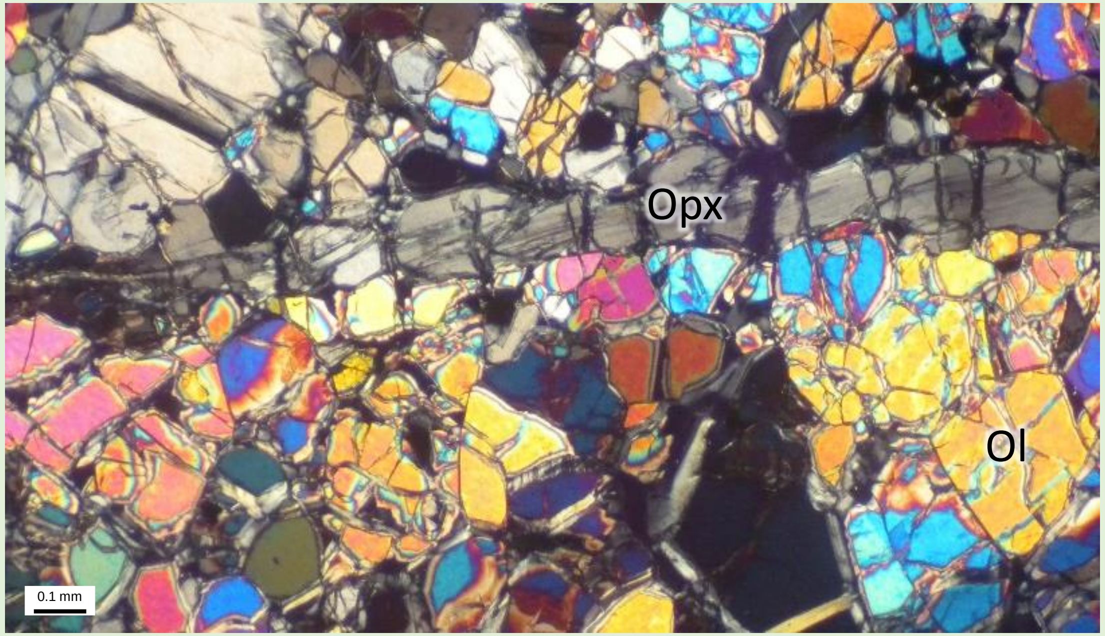
Both concordant and discordant layers are present.

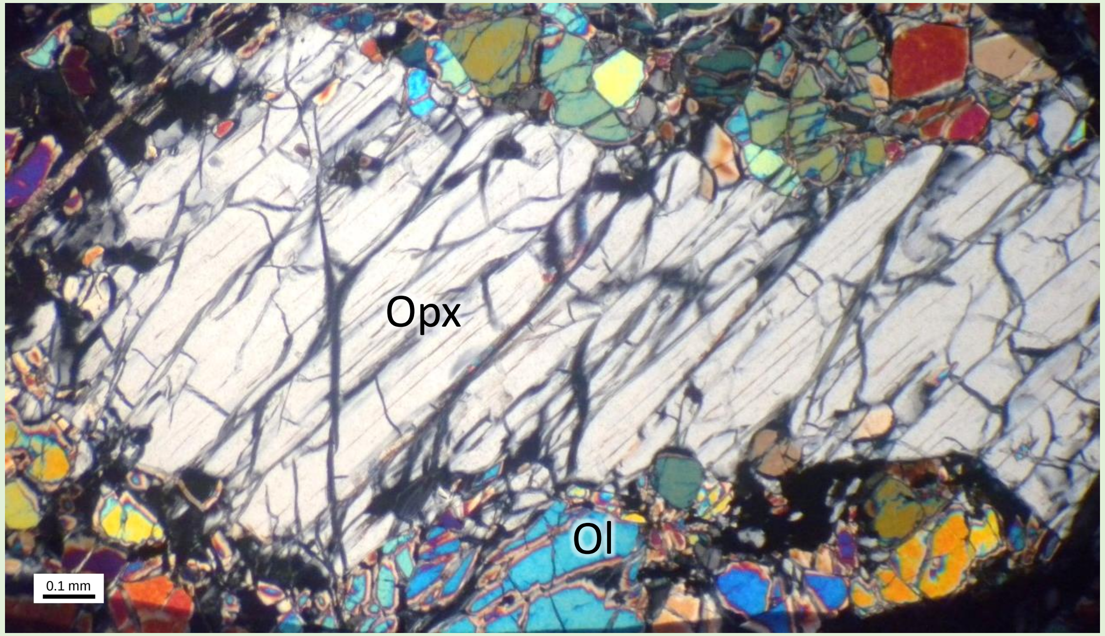






HOST HARZBURGITES





Refractory harzburgites:
Ol = 70-80 vol.%,
Opx = 20-30 vol.%
Spl < 1 vol.%
Primary Cpx is remarkably absent → very high degree of melting

Mineral chemistry
Ol: Fo = 92 mol%
Opx: high Mg# (~ 92) coupled to low Al_2O_3 (~ 1.50 wt.%) and CaO (0.64-0.81 wt.%)
High Cr# Spl = 56-65

$T_{Ca\text{-}in\text{-}Opx}$

- (exsolved) porphyroclasts = 940-970°C
- (non-exsolved) neoblasts of the mylonite = 920-930°C

T conditions of the peridotite shearing?

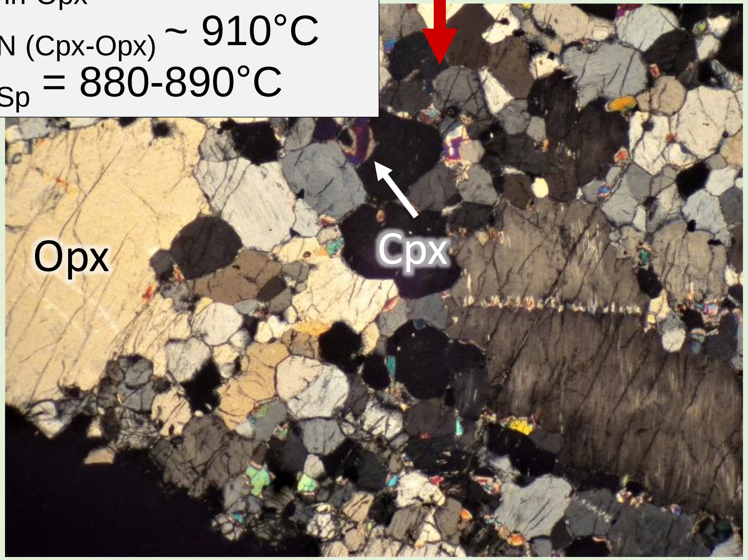
PYROXENITE VARIABILITY

ORTHOPYROXENITES

Opx ~ 95 vol.% + Spl (< 1 vol.%)
± Ol ~ 5 vol.% or ± Cpx ~ 5 vol.%

Mineral chemistry:
Opx: high Mg# ~ 92 and low Al_2O_3 = 1.67-1.89 wt.% and CaO = 0.49-0.64 wt.%;
Ol has high Mg# ~ 92
Cpx: high Mg# ~ 94; Al_2O_3 ~ 2.35 wt.%;
Na_2O ~ 0.50 wt.%

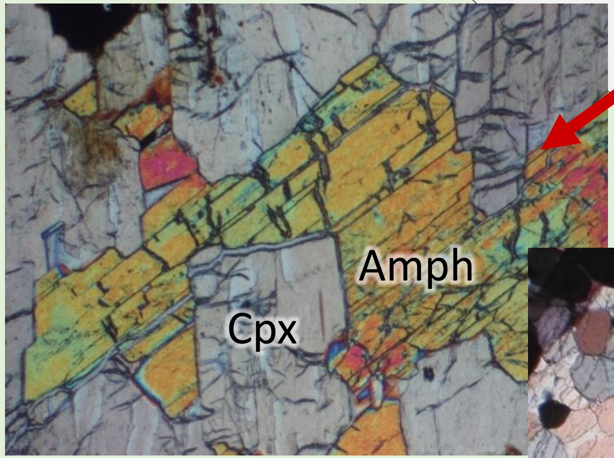
$T_{Ca\text{-}in\text{-}Opx}$ = 900-920°C
$T_{BKN\ (Cpx\text{-}Opx)}$ ~ 910°C
$T_{Ol\text{-}Sp}$ = 880-890°C



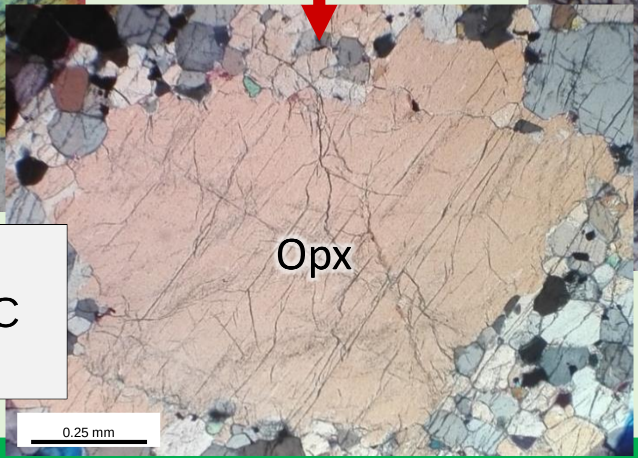
WEBSTERITES

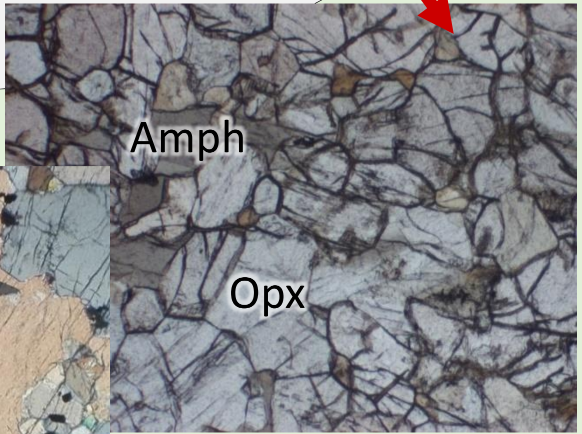
Opx ~ 40-70 vol.% + Cpx ~ 30 vol.% + Amp ~ 5-30 vol.%
Pl (up to 3 vol.%) is locally attested
Accessory: apatite and sulphides

Mineral chemistry:
Opx: Mg# ~ 79-85 and low Al_2O_3 = 0.9-1.9 wt.% and CaO ~ 0.85 wt.%;
Cpx: Mg#= 84-88; Al_2O_3 = 1.43-1.57 wt.%;
Na_2O = 0.22-0.29 wt.%
Amph is high Mg# (78-85) edenite
High-Ca Pl (An ~ 82-86)



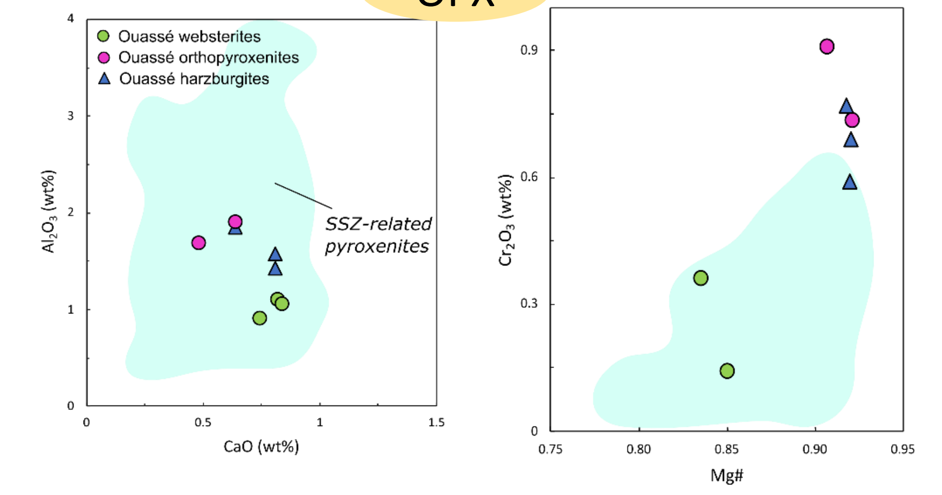
$T_{Ca\text{-}in\text{-}Opx}$ = 902-990°C
$T_{BKN\ (Cpx\text{-}Opx)}$ = 893-927°C
$T_{HB\ (Amph)}$ = 968 °C



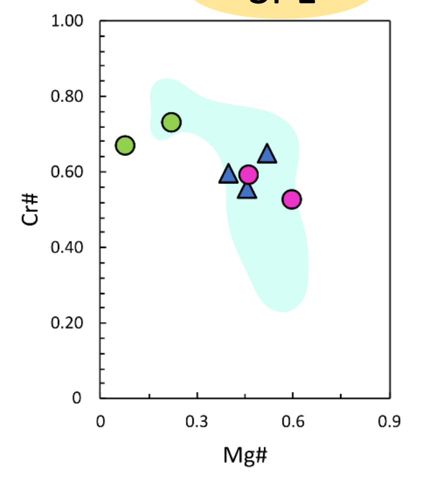


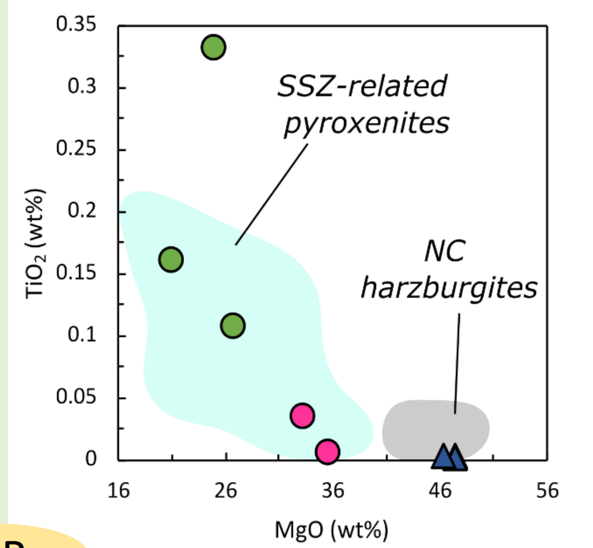
MINERAL AND WHOLE ROCK MAJOR ELEMENT COMPOSITIONS

OPX

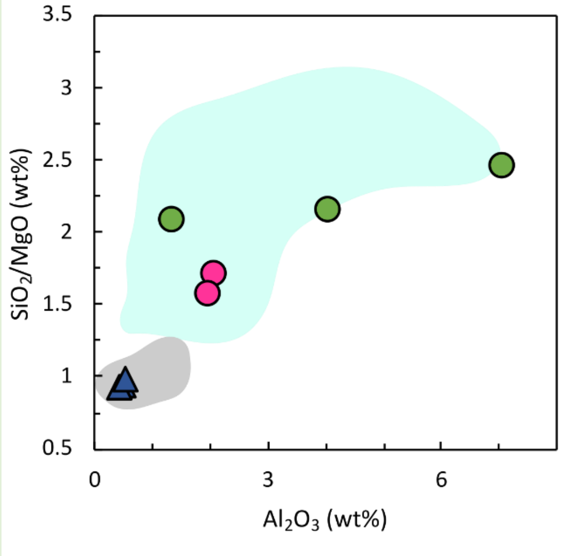


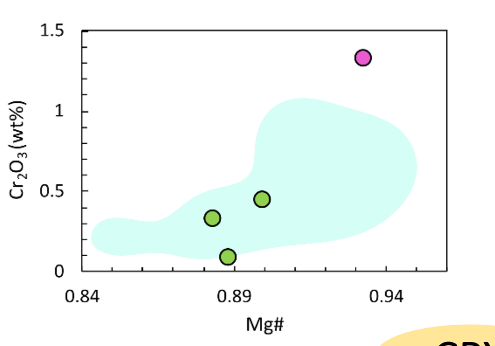
SPL



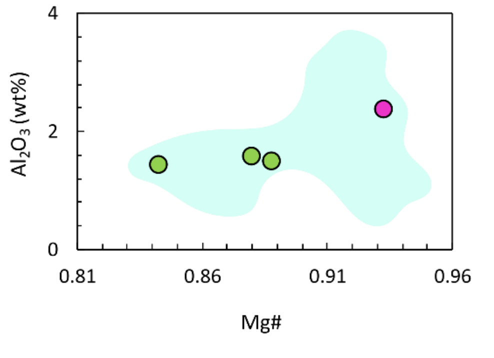


WR

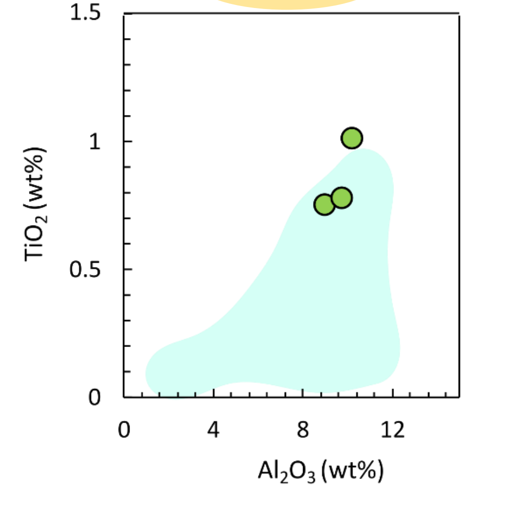




CPX



AMP



THE BOGOTA MANTLE SHEAR ZONE: EVIDENCE OF SUBDUCTION-RELATED MELT INJECTION ALONG A PALEOTRANSFORM FAULT?

The occurrence of a huge shear zone in the Bogota mantle section was well documented since the pioneering work of Prinzhofer and Nicolas (1980), who interpreted the high-T shearing of the peridotites in the framework of an oceanic paleotransform fault. More recently, detailed structural studies of the deformation patterns of the peridotites and enclosed pyroxenites over a ~50-km wide area (Titus et al., 2011 and Teyssier et al., 2016) reached similar conclusions.

No petrological and geochemical study, however, has been carried out on the pyroxenites.

The pyroxenites of this study highlight a remarkable heterogeneity of the (forearc) mantle due to emplacement of different subduction-related melts during and after the HT shearing deformation affecting the host peridotite.

The nature of the pyroxenite-forming melts, injected in highly residual harzburgites similar to modern forearc peridotites, does not seem consistent with a oceanic transform setting. We propose that the geodynamic setting of the Bogota mantle shear zone needs to be revised in the light of the new petrological results and of preliminary $^{40}Ar/^{39}Ar$ dating of amphiboles from two websterite samples of this study (Teyssier, personal communication), which provide (cooling) ages of ~56 Ma, close to the emplacement age of adakite-like dikes in the Massif du Sud harzburgites (~ 53 Ma, Cluzel et al., 2006).