



Spatial patterns of fluid- and melt-rock processes and link between melt-impregnation and metamorphism of Atlantis Massif peridotites (IODP Expedition 357)

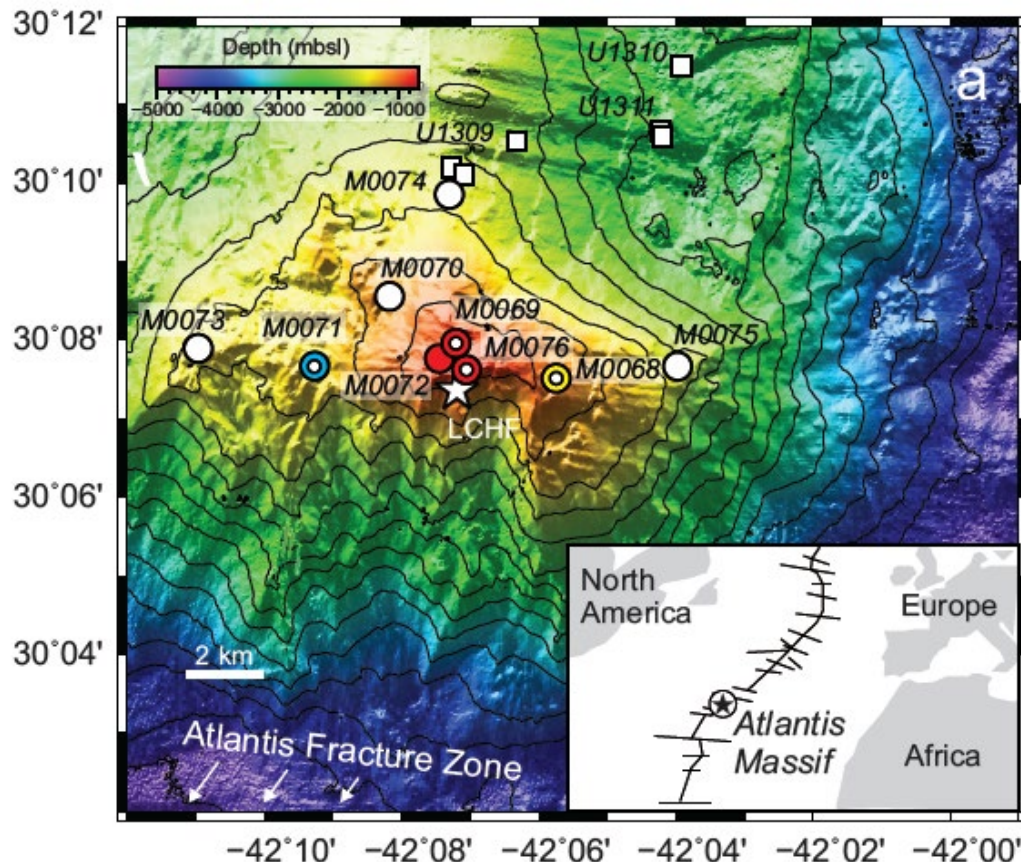
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- Using IODP Expedition 357 peridotite of the Atlantis Massif oceanic core complex (OCC), I show here that:
- (i) it is possible to discriminate dominant fluid-rock interactions from dominant melt-rock interactions in serpentinite on the basis of whole-rock (Whattam et al., 2022, based on Paulick et al., 2006) and **Cr-spinel** (Whattam et al., under review *CMP*) compositions; and
- (ii) melt-impregnation caused **contact greenschist to amphibolite metamorphism** which is recorded in Cr-spinel (Whattam et al., under review, *CMP*)

Geological setting

- The dome-shaped Atlantis Massif OCC is located at 30°N on the western edge of the MAR axial valley where it intersects the Atlantis Fracture Zone
- The OCC stretches 15–20 km N–S parallel to the ridge and is 8–12 km wide.



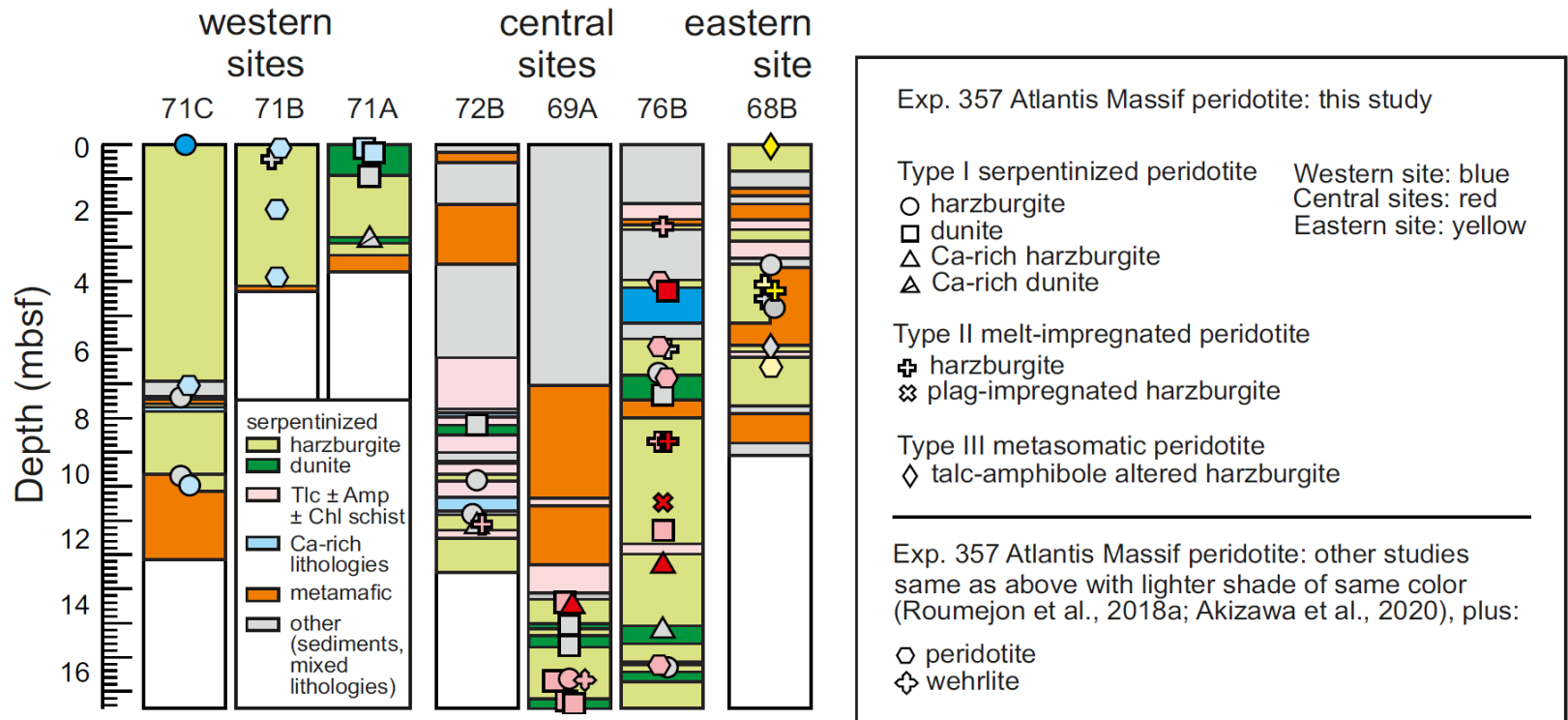
IODP Expedition 357 cored seventeen shallow holes at nine sites) along the detachment fault surface of the Atlantis Massif and recovered primarily:

serpentinized peridotite comprising harzburgite with subordinate dunite with lesser amounts of variably altered *mafic inclusions of basalt, gabbro and dolerite*

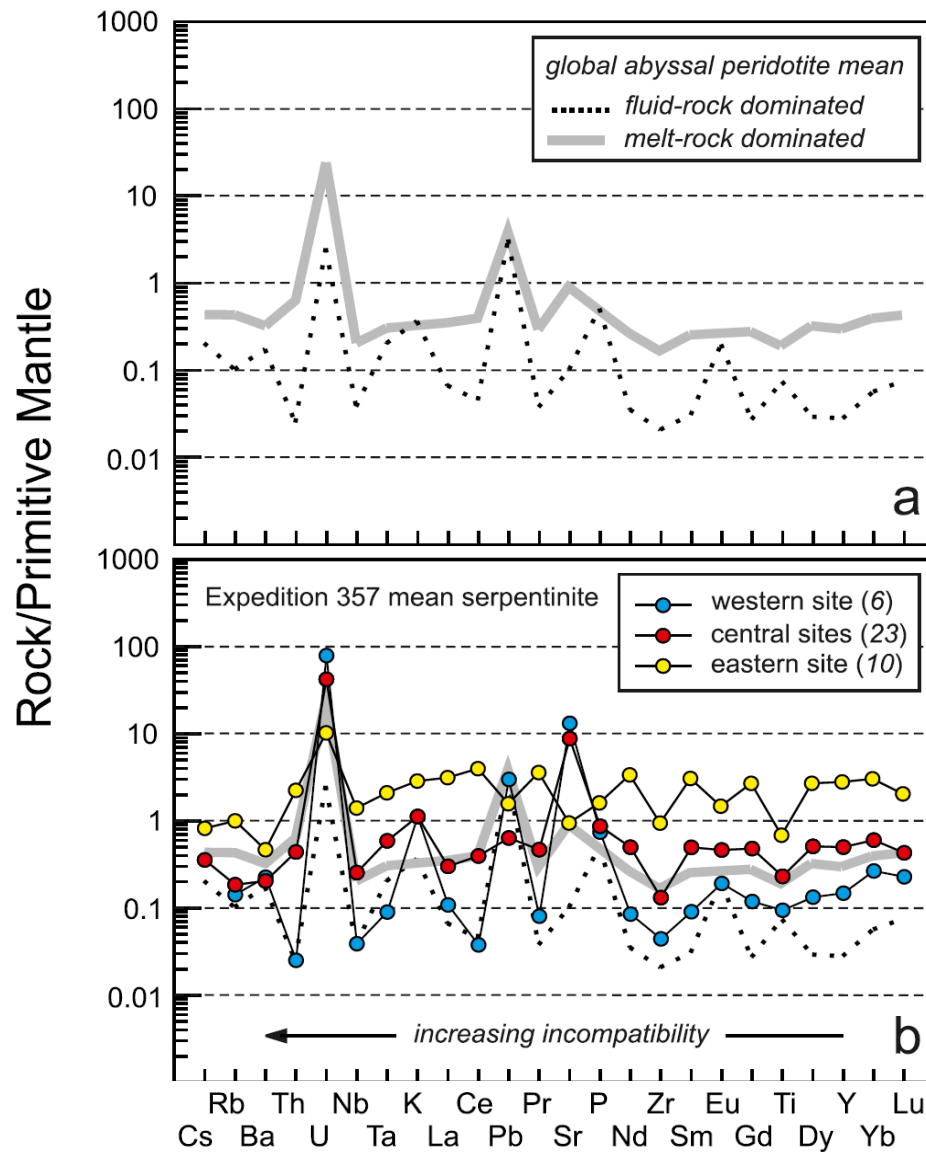
Sample types

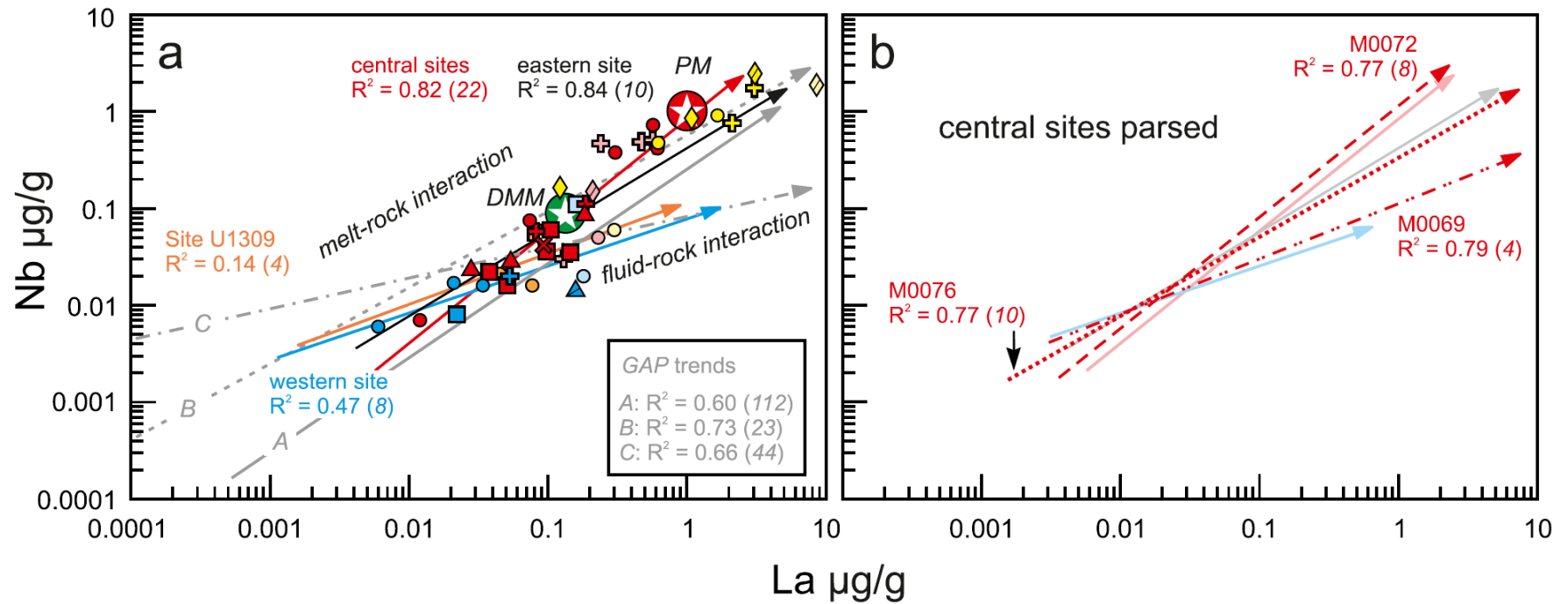
- Whole rock chemistry (Whattam et al., 2022) allows subdivision of Atlantis Massif peridotites into:
- *Type I fluid-rock dominated serpentinite*, which exhibit almost nil evidence of melt-impregnation or silica metasomatism;
- *Type II melt-rock dominated, mafic melt-impregnated serpentinite*; &
- *Type III melt-rock dominated Si-metasomatized serpentinite*.

- ***The western site essentially comprises Type I serpentinite only, whereas the central and eastern site comprise large volumes of Types II and III serpentinite***
- ***Whereas western Type I serpentinite is unmetamorphosed, many central and eastern Type II serpentinite record metamorphism up to amphibolite facies***



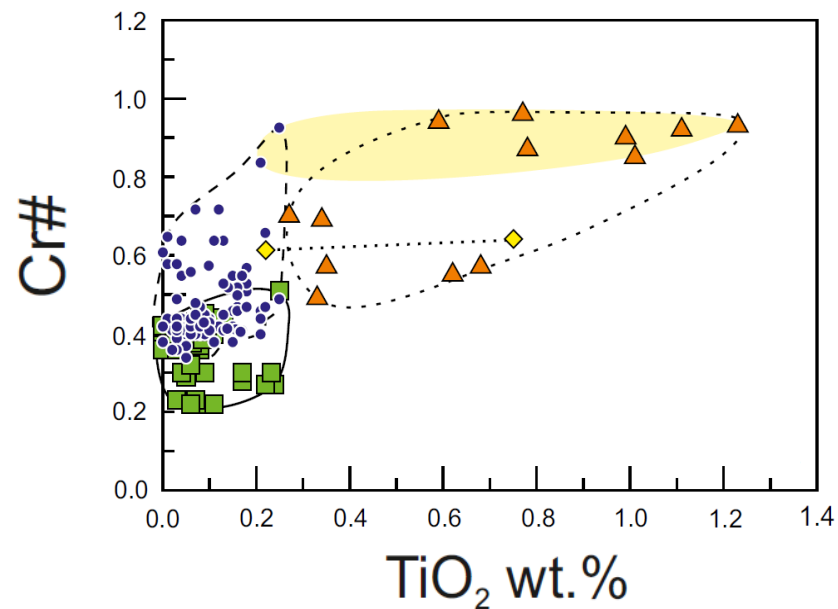
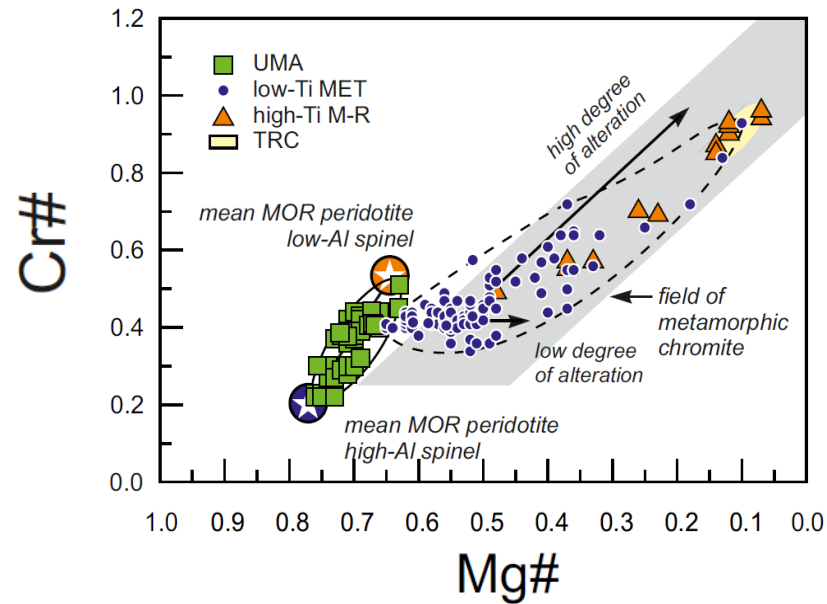
Discrimination of fluid-rock (serpentinization) & melt-rock (melt-impregnation) interaction

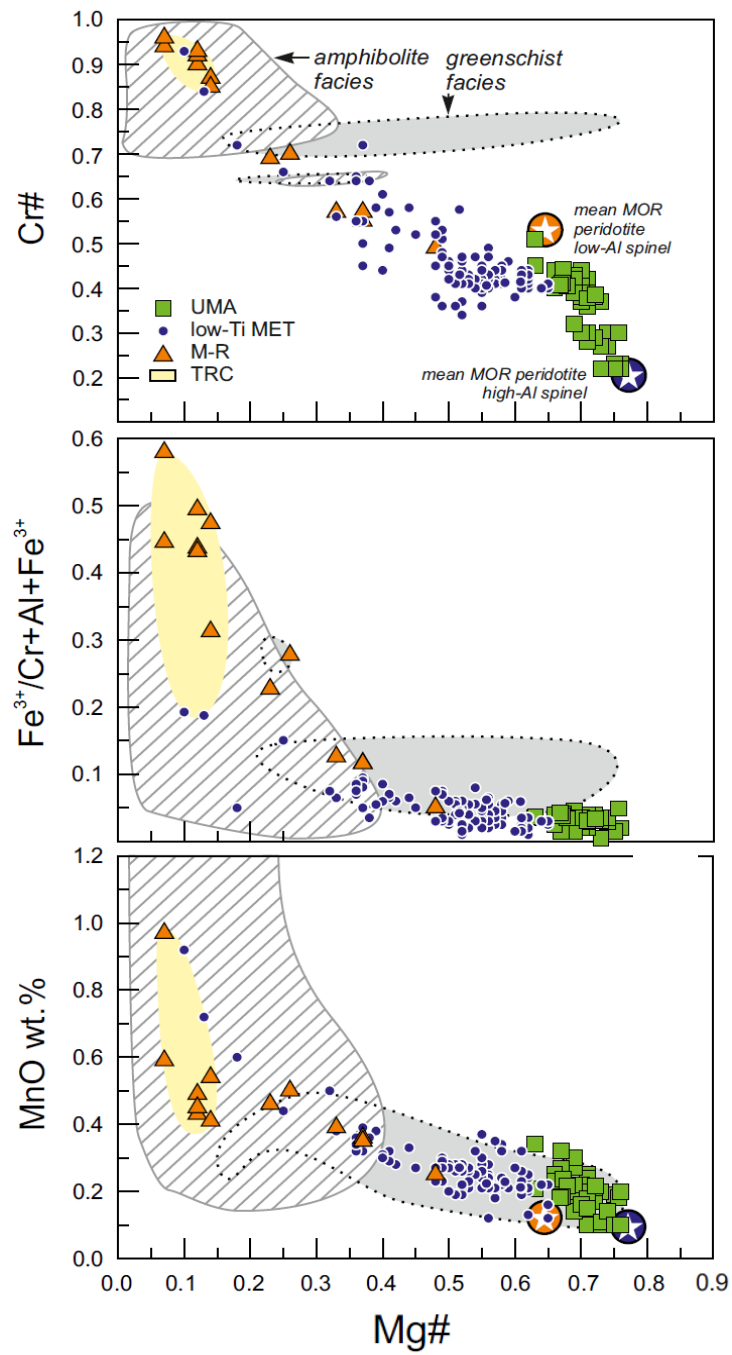


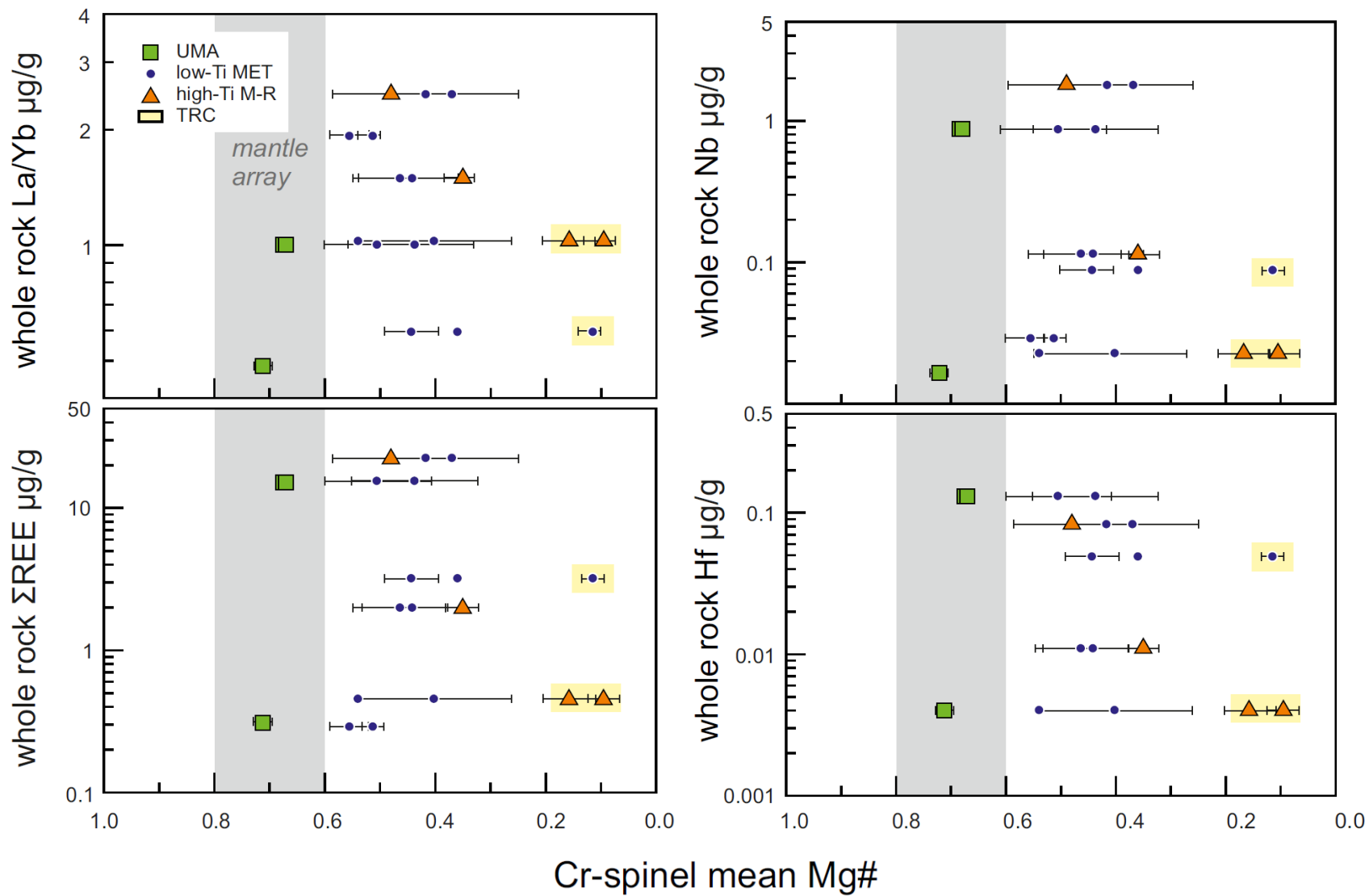


As developed and shown by Paulick et al. (2006) in study of MAR abyssal peridotites (15°20'N, ODP Leg 209)

Relation of melt-impregnation & greenschist- to amphibolite-facies metamorphism







Conclusions

- Three types of serpentinite comprise the Atlantis Massif:
- ***Type I fluid-rock dominated serpentinite***, which exhibit almost nil evidence of melt-impregnation or silica metasomatism;
Type II melt-rock dominated, mafic melt-impregnated serpentinite; &
Type III melt-rock dominated Si-metasomatized serpentinite.
- Three kinds of Cr-spinel are distinguished in the serpentinites:
- ***(I) primary, unmetamorphosed mantle array***;
(II) low-Ti metamorphosed; &
(III) high-Ti melt-reacted.
- ***All Cr-spinel of western site Type I serpentinite are unmetamorphosed; metamorphosed Cr-spinel occur in the central and eastern site Type II and III serpentinite only***
- ***Thus, a clear relationship exists between melt-impregnation and metamorphism which we postulate to be the result of heat associated with magma injection and subsequent localized, contact metamorphism.***