Introduction

Serpentinites are key in the understanding of subduction and exhumation geodynamics. They can form up to 13% of water and rock volume and are stable down to 130 km [1]. Peridotites are hydrated to form serpentinites at the base of the mantle wedge because of the release of fluids from the slab and sediments. The dehydration of these serpentinites may be responsible for deep-seismic activity [2] and partial melting in the interior of mantle wedges forming arc magmas [3]. Furthermore, because of their low density and viscosity compared to surrounding rocks, serpentinites may assist the exhumation of HP (high pressure) and ultrahigh pressure (UHP) metamorphic rocks [4].

In this study, we document bulk rock compositions and mineral chemistry of serpentinites cropping out in the Northern Subduction Complex of Hispaniola. We discuss the origins of the serpentinites and implications for subduction and exhumation processes along the northern Caribbean plate margin.

Regional Geology and Tectonics

From the Early Jurassic up to the Mid-Cretaceous, divergence between North and South America was accommodated in part by slow-spreading at the Proto-Caribbean Ridge [10]. Subsequently, between the Late Cretaceous and the Miocene, Proto-Caribbean oceanic lithosphere (part of the North American Plate) was subducted under the east migrating Caribbean Plate. Oblique collision of the Bahama Platform has since resulted in left-lateral strike-slip faulting which formed the Septentrional Fault Zone (SFZ) and the Cama Fault Zone (CFZ) [6,10].

Serpentinites crop out within the Puerto Plata Basement Complex (PPBC) and the Rio San Juan Complex (RSJC), which were continuos for 60 km of strike-slip displacements along the CFZ [5,6]. Metamorphic grade in these terranes increases from north to south from the low metamorphic grades in the serpentinite melanges in the PPBC and northern RSJC to the blueschist and eclogite bearing serpentinite melanges in central RSJC, to the retrograded eclogites of the Cuaba Unit which contain lenses of UHP-garnet peridotites in the southern part of the RSJC (Figure 2). In addition, serpentinites are concentrated near the CFZ and the SFZ which bound the indies.

Theory: Possible Origins of Serpentinites in Subduction Complexes

1) Abyssal Peridotite exposed and hydrated on the sea floor forming ultrahigh pressure (UHP) rocks during active subduction and during late post-collisional transpression.
2) Forearc Peridotite hydrated at the base of the mantle wedge by fluids from slabs and sediments forming hypo-abyssal compositions, high Cr spinel in spinelites, very high in IGPES.
3) Hydrated ultramafic cumulates from the oceanic lithosphere forming highly refractory compositions, low in Ni, Cr and IGPES.

NOT observed in this study...

Results

All studied samples from the Northern Subduction Complex of Hispaniola are interpreted as mantle residues based on their depletion in inclusions of primoridial silicates, and their relatively flat to PDS-depleted PDS patterns.

However, samples from the SFZ and the CFZ show a higher degree of depletion than samples from the Northern Terranes and the HP-LT Melanges: they have depleted bulk composition and Crs in spinel similar to forearc peridotites [10]. The southern part of the RSJC also shows depleted Crs and CFZ serpentinites originated from the forearc mantle, whereas those from the Northern Terranes and the HP-LT Melanges were abyssal peridotites.

Conclusions

The Proto-Caribbean lithosphere was generated at a slow-spreading ridge (2 cm/yr [18]): therefore, abundant peridotite was exposed on the sea floor. This is consistent with the high proportion of hydrated abyssal peridotites in the RSJC. During subduction, the buoyant and ductile oceanic serpentinites were exhumed together with blueschist and eclogite blocks to form the HP-LT Melanges of the RSJC.

Forearc serpentinites formed at the base of the mantle wedge. The occurrence of these serpentinites along post-collisional strike-slip fault zones suggests that they used these zones of weakness for pretrusion.

Bluechisit blocks occur in serpentinite melanges near the CFZ [5,6] and were incorporated during posttrusion. Furthermore, serpentinites from the SFZ are spatially associated with eclogites and garnet peridotites. The evidence suggests that forearc serpentinites contributed to exhumation of HP and UHP rocks during active subduction and during late post-collisional transpression.

Acknowledgements

Many thanks to Peter Jones for assistance on the microprobe, Monika Wilk-Alemany for help with ICP-MS analyses, Ron Hartree for XRF and XRD analyses, George Mrazek for polished thin sections, and Dominique Bastien for his advice on the figures. Financial support was provided by the Ministry of Training, Colleges and Universities of Ontario, Le Fonds Quebécois de la Recherche sur la Nature et les Technologies, the University of Ottawa and the Faculty of Graduate Studies. The research was supported in part by NSERC grants to K. K. Hattori and S. Guillot.

References