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# A Dynamic study of Mantle processes applying In-situ Methods to Compound Xenoliths: implications for small to intermediate scale heterogeneity

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The mantle is the major geochemical reservoir of most rock-forming elements in the Earth. Convection and plate-tectonic driven processes act to generate local and regional heterogeneity within the mantle, which in turn through thermal and chemical interactions modulates ongoing geophysical processes; this feedback shapes the dynamics of the deep interior. Consequently, these processes contribute to the evolution of the earth throughout its geological history.

Up to now, the heterogeneity of the mantle has been extensively studied in terms of conventional methods using basalt chemistry, bulk rock and mineral major and trace element analysis of isolated xenolith specimens of varying lithology, and massif exposures. The milestone of the present study, part of an ongoing research project, is the application of in-situ analytical methods such as microprobe, LA-ICP-MS and high resolution SEM in order to provide high quality major and trace element analyses as well as elemental distribution of the coexisting phases in the preserved intra-mantle lithologies,

Particularly, in the context of the current study we used selected compound xenoliths from San Carlos (Arizona, USA), Kilbourne Hole (New Mexico, USA), Cima Dome and Dish Hill suites (California, USA), San Quintin (Baja California, Mexico) and Chino Valley (Arizona, USA), from the Howard Wilshire collection archived at the Smithsonian Institution. The selection of these compound xenoliths was based upon freshness and integrity of specimens, maximum distance on both sides of lithologic contacts, and rock types thought most likely to represent subsolidus juxtaposition of different lithologies that later partially melted in contact. The San Carlos samples comprise composite xenoliths with websterite, lherzolite and clinopyroxenite layers or clinopyroxenite veins surrounded by lherzolite or orthopyroxenite-rich rims. The Kilbourne Hole suite comprises spinel-(olivine) clinopyroxenite and orthopyroxenite dikes cutting spinel lherzolite (Irving 1980). The Dish Hill volcanic field contains lherzolite xenoliths with amphibole-rich veins previously interpreted by Wilshire et al. (1980) in terms of reaction of a $H_2O$- and Fe-rich fluid with the lherzolite host producing notable losses of Mg and Al. The Cima volcanic field, located in the southern Basin and Range province, provides samples with contacts among such diverse lithologies as Cr-diopside spinel peridotite, websterite, gabbro, clinopyroxenite and wehrlite (Wilshire et al. 1991). The San Quintin example contains large websterite veins crosscutting lherzolite matrix. Chino Valley xenoliths show cumulate textures with alternating orthopyroxene- and clinopyroxene-rich layers.

We discuss and assign the observed reaction textures and mechanisms between the different minerals (e.g. olivine, clinopyroxene, orthopyroxene), layers (e.g. clinopyroxenite and lherzolite) and the consequent compositional changes across/among the minerals and the lithologic contacts. Thus, we characterize the possible genetic origin scenarios for the observed contacts between adjacent lithologies of the composite xenoliths. Those examples, most likely to represent original subsolidus contacts that underwent partial melting together, will have the most direct relevance as benchmarks for application of future kinetic models of melt extraction from heterogeneous mantle lithologies.

## References

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