Paragenetic types of carbonatite as indicated by the diversity and relative abundances of associated silicate rocks: Evidence from a global database

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Data on the diversity and relative abundance of igneous rock types associated with carbonatites have been compiled for 477 occurrences, which represent 90% of the 527 known occurrences. The carbonatites have been subdivided into magmatic (84%) and carbohydrothermal (16%) carbonatites. Carbohydrothermal carbonatites are defined as those precipitated at subsolidus temperatures from mixed CO_2–H_2O fluids that can be either CO_2-rich (carbothermal), or H_2O-rich (hydrothermal). The fluids can be from either alkaline silicate or carbonatite magmas but are typically associated with nepheline syenites and syenites. For the magmatic carbonatites, 24% of these localities have no associated igneous silicate rocks, while a diverse range of silicate rock types are recognized to be associated with the other 76%. Seven main silicate rock associations can be distinguished: 1. nephelinite-ijolite (28%), 2. phonolite-feldspathoidal syenite (14%), 3. trachyte-syenite (8%), 4. melilitite-melilitolite (7%), 5. lamprophyre (5%), 6. kimberlite (1%), 7. basanite- gabbro (<1%). A significant proportion of the nephelinite-ijolite and melilitite-melilitolite associations, and carbonatite only group contain ultramafic rocks, which are interpreted as cumulates. Whereas these dunite and pyroxenite bodies might typically be considered as cumulates from silicate magmas, the possibility exists that these rocks are cumulates related to a carbonatite magma. The existence of olivine- and diopside-bearing carbonatites suggests that the potential to generate ultramafic cumulates from carbonatite magma is feasible. Thus it is possible that some carbonatite-ultramafic rock associations (10% of the magmatic localities) could be related to a carbonatite-only paragenesis.

The carbonatite only, plus some of the carbonatite-ultramafic cumulate localities are interpreted to be derived from primary mantle derived carbonatite magmas. However, most other carbonatites are considered to have been generated by differentiation from magmas represented by the associated silicate rocks that are the result of partial melting in a metasomatised lithosphere. The preferred model is that carbonatites can be generated in a number of ways, but the close spatial and temporal association with a broad spectrum of the silicate melts implies a close relationship with them.

Relationships between mantle and crust melt distribution and surficial geology and geochemistry at the 9degrees 03'N Overlapping Spreading Center, East Pacific Rise

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A goal in the study of ocean ridges is to understand linkages in the magmatic system from the deep mantle to its surface expression at the seafloor. To explore these linkages, we undertook a geochemical, geological and hydrothermal investigation of the 9 deg 03'N OSC, EPR. Previous geophysical work provides detailed information on the distribution of melt in the upper mantle and crust. We conducted a 35-day cruise (AT15-17) to the OSC; we surveyed with DSL-120A, mapped and sampled with ROV Jason II, and mapped with the WHOI TowCam. Examination of the relationship between the spatial distribution of melt at depth and the loci of recent magmatism revealed no evidence of recent eruptions overlying the plunging melt sill beneath the southern portion of the East Limb or that beneath the West Limb. West of the northern portion of the East Limb, where seismic studies image a wide off-axis melt sill, younger lavas with glassy buds and eruptive fissures suggests relatively recent volcanism. Lava compositions range from basalt to dacite: 33% have SiO_2 > 52 wt%. Trace elements reveal complex spatial systematics suggesting variations in source composition, extents and depths of melting, crustal evolution and assimilation. Data will be used to explore linkages between geochemical, geological, and hydrothermal variations on the seafloor and the magma supply system at depth.