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Links between carbonate alteration in orogenic gold deposits and alkaline magmatism

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During the Miocene, orogenic gold deposits and lamprophyric magmas were emplaced contemporaneously in the proto-Southern Alps of New Zealand. These two systems have some striking similarities such as (1) the shared preferred orientations of the gold-bearing structures and the lamprophyric dikes, (2) the association with extensive, structurally controlled (dominantly Fe-rich) carbonate alteration, and (3) the shallow emplacement level into a quartzofeldspathic terrane. The abundance of the carbonate alteration is particularly notable as crustal sources for the CO_2 such as marbles or carbonate minerals within the host rocks are very rare. A possible source could be related to the alkaline magmatic suite which, N of the study area, also contains mantle-derived carbonatites. To ascertain whether this could be the case, we have examined the geochemistry and isotopic properties of the Fe-carbonates that have precipitated in both systems, in veins as well as as replacing minerals within the host rock. The alteration haloes extend up to 10s of metres into the wallrock, where the replacement of metamorphic minerals such as chlorite and epidote distal to the fault zone attests to an extensive flux of CO_2-rich fluids. Trace element data from these haloes, obtained in-situ using LA-ICP-MS, reveals introduction, mobilisation and redeposition of major and trace elements, such as Ca, K, Sr and REE. Sr isotope and trace element data suggest that the Fe-carbonates related to the lamprophyres have at least partly a genetic link to the carbonatites. Thus, some of the Miocene CO_2 appears to have had a mantle origin. The carbonates related to the gold-bearing structures have more radiogenic 87Sr/86Sr ratios, which may be due to the interaction of the fluid with the relatively radiogenic host rocks as the signatures seem to depend on the type of wall rock (quartzofeldspathic- or greenschist). Tests are in progress to establish whether the gold-bearing carbonates could have formed by interaction of mantle derived fluids and crustal rocks.