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GEOCHEMISTRY

Resurfacing subducted carbon

Subduction zones recycle a number of critical life-supporting elements between the biosphere and geosphere, including carbon. While some subducted carbon is released back to the near-surface, the remainder is taken deep into the mantle and could be isolated from the biosphere for millions or billions of years. However, the efficiency of carbon recycling at subduction zones is difficult to constrain and therefore hotly debated.

Forrest Horton, at the Woods Hole Oceanographic Institution, USA, analysed the geochemistry of the carbonatite Khanneshin volcano in southern Afghanistan to help quantify carbon recycling at the Makran subduction zone. The Khanneshin volcanic products are spatially and temporally associated with the Makran subduction zone, where the Arabian plate subducts northward beneath Eurasia. Combining strontium isotope ($^{87}Sr/^{86}Sr$) ratios and ^{40}Ar–^{39}Ar geochronology revealed that the Khanneshin volcano is 3.8 million years old, and its magmatic precursors were derived from marine sediments deposited at 28.9 ± 1.4 Ma (an age which coincides with Indus Fan growth). These results indicate that carbon from the submarine Indus Fan was subducted into the Makran Trench and efficiently returned to the near-surface within ~27 million years or less. The large flux of carbon-rich sediments into the Makran Trench is the likely explanation for why a subduction zone carbonatite volcano exists here, but nowhere else on Earth.

Credit: Jean-Denis JOUBERT/Gamma-Rapho via Getty Images

Khanneshin volcano was not previously associated with subduction processes, but this evidence implies that carbonatite volcanoes can be generated in back-arc settings. Although it is likely the Makran subduction zone could be a unique high-flux setting, further work should aim to constrain the implications of such a notably fast and efficient turn-around of subducted carbon on global carbon cycle models over geological time.

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