Depth of melt segregation below the Nyos maar-diatreme volcano (Cameroon, West-Africa): major-trace element evidence and their bearing on the origin of CO2 in Lake Nyos

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The Nyos maar-diatreme volcano on the Oku Volcanic Group (OVG) in NW Cameroon carries yet the most infamous maar lake in the world because the lake exploded in 1986 releasing CO2 that killed about 1750 people and over 3000 livestock. A process of safely getting rid of accumulated gas from the lake started in 2001. Even though about 40 per cent of it has been removed, gas continues to seep into the lake from the mantle, so the lake still poses a thread. Available data on basaltic lava from the maar-diatreme volcano and other volcanoes of the OVG are used here to determine the depth and location where the magmas are produced, and to make inferences on the generation of CO2 in the Nyos mantle. Fractionation-corrected major element data agree well with experimental data on mantle peridotite and suggest that Lake Nyos magmas formed at pressures of 2-3 GPa in the garnet stability field. This inference is corroborated by trace element models that indicate small degree (1-2 per cent) partial melting in the presence of residual garnet (2-3 per cent). The basalts have elevated High Field Strength Element (HFSE) ratios (Zr/Hf = 48.5 + 1.2 and Ti/Eu = 5606 + 224) which cannot be explained by any reasonable fractional crystallization model. A viable mechanism would be melting of a mantle that was previously spiked by percolating carbonatitic melts. It is suggested that small degree partial melting of this metasomatised mantle produces the lavas with super chondritic HFSE ratios, and is generating the CO2 that seeps into and accumulates in the lake, and which asphyxiated people and animals during the 1986 gas disaster. This finding requires that current efforts to degas Lake Nyos should take into account the fact that CO2 will continue to seep into the lake for a yet undetermined but long time in the future. A viable solution would be to avoid renewed stratification of the lake, by (somehow) safely and permanently bringing bottom gas-charged waters to the surface to release gas, even after the gas currently stocked in the lake has been completely removed.

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