

EGU2020-8485

<https://doi.org/10.5194/egusphere-egu2020-8485>

EGU General Assembly 2020

© Author(s) 2020. This work is distributed under the Creative Commons Attribution 4.0 License.



Using wehrlites to monitor the passage of CO₂-bearing melts in the shallow lithosphere

Sonja Aulbach, A-Bing Lin, Yaakov Weiss, and Gregory Yaxley

Goethe University, Institut für Geowissenschaften, Frankfurt am Main, Germany (s.aulbach@em.uni-frankfurt.de)

Continental rifting has been linked to the thinning and destruction of cratonic lithospheres and to the release of enough CO₂ to impact the global climate [1]. This fundamental plate tectonic process facilitates the infiltration and/or mobilisation of small-volume carbonated melts, which interact with mantle peridotite to form wehrlite through the reaction: enstatite + CO₃²⁻ (melt) = forsterite + diopside + CO₂ (vapour) [2]. An analysis of the literature reveals that wehrlites are common in shallow mantle lithosphere in disrupted craton settings affected by either extension or subduction, and they have been linked to agents ranging from carbonatites to basanites [e.g. 3,4]. Conversely, the low abundance of wehrlitic diamond and garnet in cratonic mantle xenoliths (as opposed to lherzolitic or harzburgitic) indicate that wehrlitisation is not an important process at depths >~120 km. This may be due to the presence of a dominantly reducing lithosphere, which favours diamond precipitation or dissolution during reaction with carbonated silicate melts, depending on carbon saturation. Based on the relationship between wehrlite and small-volume carbonated melts, we suggest that wehrlite-bearing xenoliths can be used to monitor CO₂ mobility through the shallow continental lithosphere. Assuming a depleted protolith, typically harzburgite at shallow lithospheric depth, the amount of newly-added cpx can be estimated and related to CO₂ in the melt volume based on the above reaction. Considering the proportion of wehrlite in the xenolith population, an estimate of the total CO₂ transported out of the shallow lithosphere can be made. For example, peridotite xenoliths from Liaoyuan in the reactivated northeastern North China craton sample the mantle beneath the mid-Cretaceous Tan Lu Fault Belt (TLFB), which is even vaster in size (5000 x 800-1000 km) than the EAR, the latter linked to degassing of 28 to 34 Mt C/yr over 40 Ma [1]. If wehrlitisation affected only a 10 km depth interval over a similar time, 23 Mt C/yr has passed through the TLFB, possibly contributing to the mid-Cretaceous greenhouse climate. Thus, wehrlites reveal the hidden carbon cycle in lithospheric provinces where CO₂-rich melts are not necessarily observed at the surface.

[1] Foley and Fischer 2017 *Nature Geosci* 10; [2] Yaxley et al. 1998 *J Petrol* 39; [3] Aulbach et al. *J Petrol* 2017 58; [4] Lin et al. *subm. J Geophys Res*