Preliminary study of the thermal structure of the oeanic crust ˜A new approach using crystal size variations of the sheeted dikes

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We present a new approach of estimation of the thermal structure of the upper crust beneath the Oman paleospreading axis using the crystal size variations of the sheeted dike complex. A numerical simulation of crystallization in a dike shows that logarithm of crystal size is linearly correlated with square root of growth time of the crystal [Spohn et al., 1988]. Umino applied this relationship to the crystallization of multiple dikes in ODP Hole 504B and successfully estimated the time intervals of dike intrusions [Umino, 1995]. The wall rock temperature is also correlated with logarithm of crystal size in the center of a dike [Spohn et al., 1988]. Therefore, we can estimate the wall rock temperatures at the time of the dike intrusion using the crystal size variations in the dike. Because dike intrusion is limited to a narrow volcanically active zone (less than 1 km in width) beneath the fast-spreading axis, the groundmass crystal sizes of the sheeted dikes represent the thermal structure of the upper crust at the ridge axis.

We applied this relationship between the crystal sizes and the wall rock temperatures to the sheeted dike complex of the Oman Ophiolite and estimated the thermal structure of the upper crust beneath the Oman paleospreading axis. Assuming the liquidus temperature of 1150 deg C for the basaltic dikes and the ambient temperature of the top of the sheeted dike complex to be 100 deg C, the estimated wall rock temperature varies from 180 deg C at 570 m and 670 deg C at 990m in depth from the boundary between the effusive rocks and the dike complex, and 530 deg C at the boundary between the dike complex and the upper gabbros. Then the thermal gradient is estimated to be 1.7 deg C/m for the lower 330 m of the sheeted dike complex.

References
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