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Controlling oxygen fugacity in piston cylinders

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A double capsule assembly designed to control oxygen fugacity in piston cylinder experiments has been tested at 1200 °C and 10 kbar. The assembly consists of an outer Pt-capsule, an inner AuPd-capsule, containing the sample, water and a Pt-wire, and a solid buffer (Ni-NiO or Co-CoO plus H_2O). To prevent direct contact with the buffer phases the AuPd-capsule is embedded in finely ground Al_2O_3 along with some coarser, fractured Al_2O_3 allowing for fluid inclusion formation.

No water loss is observed in the sample even after 48 hrs but a slight increase in water content is observed in longer duration runs due to oxygen diffusion into the AuPd-capsule. Carbon from the furnace also diffuses through the outer Pt-capsule[1] and into the inner capsule even though the activity of C in the outer capsule is less than one. In an experiment with Fe as starting material, siderite ($FeCO_3$) and wüstite (FeO) were found along the capsule/Fe boundary and in the AuPd-capsule-walls.

Oxygen fugacity of runs in equilibrium with the Ni-NiO and Co-CoO buffers was measured by analyzing the Fe content of the Pt-wire in the sample[2] and by analyzing Fe in the AuPd capsule[3]. The second method gives values that are in good agreement with established buffer values whereas results from the first method are one half to one log units higher than the established values.

References

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