

# Carbon dioxide fugacities at high temperature and pressure

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The PVT properties of C-O fluids are of fundamental importance to the stability and behaviour of carbon bearing species in the Earth's lower crust and mantle. Despite this importance, reliable experimental data for carbon dioxide only exist to the relatively low pressure of 10 kbar. Although many equations of state have been used to extrapolate these data to greater pressures, accurate experimental determinations are required to test and improve such equations.

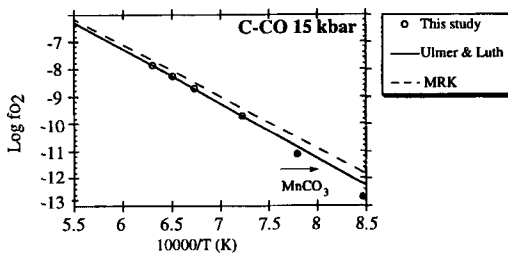


FIG. 1. Results of experiments on graphite-CO fluid equilibrium between 900 and 1300°C and 15 kbar. Filled symbols denote  $\text{MnCO}_3$  present in run products.

We have measured the fugacity of pure  $\text{CO}_2$  in the pressure and temperature range 10–50 kbars 900–1600°C by determining the  $f_{\text{O}_2}$  of the graphite- $\text{CO}_2$  equilibrium. Experiments up to 30 kbars were performed using a mixture of Ni metal and (Ni,Mn)O solid solution as a sliding redox sensor (Pownceby and O'Neill, 1994). The composition of the solid solution shifted rapidly to equilibrate with the imposed  $f_{\text{O}_2}$  which could be accurately calculated (figure 1). However the stability of rhodochrosite ( $\text{MnCO}_3$ ) precluded the use of this sensor for measurements at higher pressures. For

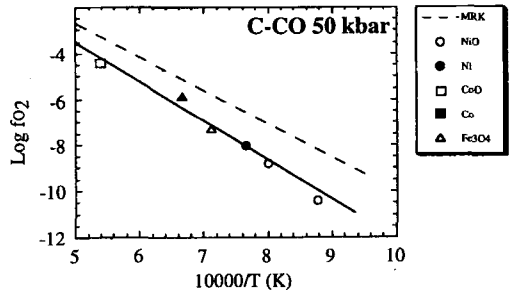


FIG. 2. Result of experiments on graphite-CO fluid equilibrium between 900 and 1500°C and 50 kbar. Open symbols denote oxidized phase and filled denote deduced phase

experiments between 35 and 70 kbars pure metal-oxide redox sensors were utilised to bracket the C-CO equilibrium (figure 2).

Our results show excellent agreement with the work of Ulmer and Luth (1990) in the pressure range of their study (10–30 kbars). However we find  $\text{CO}_2$  to be more compressible than predicted by the MRK equation of state over the entire pressure and temperature range of this study. This has important implications for the stability of carbonate and other carbon bearing phases in the Earth's mantle.

## References.

- Pownceby, M.I., O'Neill, H.St.C. (1994) *Thermodynamic Data from Redox Reactions at High Temperatures: V. Thermodynamic Properties of NiO-MnO Solid Solutions from EMF Measurements*. Unpublished.
- Ulmer, P., Luth, R.W. (1991) *Contrib. Mineral. Petrol.*, **106**, 265–72.