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Loss of iron to gold capsules in rock-melting experiments

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ABSTRACT

Gold is used widely for capsules in high-temperature rock-melting studies because it is generally thought to absorb negligible Fe from silicate samples. However, we observed significant losses of Fe from fluid-absent melting experiments on hornblende gabbros at 800–975 °C and 8 kbar, using standard piston-cylinder techniques. The extent of Fe loss from the sample is dependent on the relative masses of the sample and the capsule. Low sample to capsule mass ratios (~0.04) lead to the highest Fe losses (32–49% relative). Concentrations of Fe in silicate melt and used gold capsules define an apparent equilibrium constant (K') that follows a linear ln K' vs. $1/T$ relation (at an estimated log f_{O_2} of QFM-1). The apparent equilibrium constant is used to make limiting upper estimates on the amount of Fe that could be lost during rock-melting experiments for a range of f_{O_2} and sample to capsule mass ratios. At high f_{O_2} (NNO + 2), loss of Fe to gold is negligible (<2% relative) for a wide range of sample to capsule mass ratios. At an f_{O_2} of NNO, Fe loss can be kept to <10% relative by using a sample to capsule mass ratio of 0.2 or greater. At low f_{O_2} (QFM-1), presaturating the Au with Fe would be necessary to ensure that Fe losses remained <10% relative. Fe loss can compromise experimental results for small samples run at low f_{O_2} conditions, be they buffered, imposed by the pressure media, or produced by intrinsically reduced (graphitic) starting materials.