

Holloway J R & Burnham C W. Melting relations of basalt with equilibrium water pressure less than total pressure. *J. Petrology* 13:1-29, 1972.

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Experiments are described in which a Hawaiian basalt was melted at high partial pressures of H<sub>2</sub>O. Three aspects of the study were new: H<sub>2</sub>O partial pressure was controlled independently of total pressure; modal proportions of resulting phases were calculated by inverting the measured phase compositions, allowing calculation of hornblende melting stoichiometry; and it was observed that hornblende stability increased with decreasing H<sub>2</sub>O activity. [The SCI® indicates that this paper has been cited over 90 times since 1972.]

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"When I began rock melting experiments as a graduate student at Penn State University, two kinds of studies had been done. In one, volatiles were completely absent<sup>1</sup> and in the other an excess amount of H<sub>2</sub>O was present.<sup>2</sup> Evidence suggested that the situation in nature was somewhere in between, but no experimental technique was in use which would allow the partial pressure of H<sub>2</sub>O to be controlled at some value less than total pressure. At the time I was doing a project assigned by my advisor, C. Wayne Burnham, involving phase equilibria studies at 15-20 kilobars in a gas medium pressure vessel. The vessel, which was always difficult to use, had a habit of blowing up. It had done so twice in the hands of my predecessor, once when I was running it. A six-month period was needed to repair it after each failure, so when I blew it

up a second time I decided that if I was ever going to finish my thesis, I would have to come up with another project—one which could be done in a lower pressure range where several vessels were available.

"For the previous year I had been musing over the problem of controlling H<sub>2</sub>O partial pressure with my fellow students, especially Rosiland Helz, who had the misfortune to sit at a desk directly opposite mine. For months we were unable to come up with a useful approach and I was reduced to reading the *Handbook of Chemistry and Physics* tables for a diversion.<sup>3</sup> I came across the compound oxalic acid dihydrate which looked possibly useful, but complex. Then, it dawned on me that H<sub>2</sub> produced in its dissociation would diffuse through the platinum capsule wall, leaving behind a nearly pure mixture of CO<sub>2</sub> and H<sub>2</sub>O. Subsequent analysis proved this to be so, and the technique was suddenly available.

"I chose a Hawaiian basalt for the experiments. The most surprising result was that decreasing H<sub>2</sub>O activity at constant total pressure caused an increase in the thermal stability of the hornblende. At the time, I did not have a satisfying explanation for that phenomenon. The next four years were spent doing experiments to unravel the puzzle, and I published the experimental results.<sup>4</sup> This year a student and I finished a quantitative theoretical treatment which will appear as a sequel to the 1973 paper.

"I suspect the 1972 paper has often been cited because it illustrated the technique of controlling H<sub>2</sub>O activity independently of total pressure in rock melting experiments. Introduction of the technique not only made new experiments possible, it changed the way we thought about the way rocks melt."

1. Yoder H S & Tilley C E. Origin of basalt magmas: an experimental study of natural and synthetic rock systems. *J. Petrology* 3:342-532, 1962.

2. Green D H & Ringwood A E. The genesis of basaltic magmas. *Cmtrib. Mineral. Petrol* 15:103-90, 1967.

3. Weast R C & Selby S M, eds. *Handbook of chemistry and physics*. 47th edition. Cleveland: Chemical Rubber, 1965.

4. Holloway J R. The system perargasite-H<sub>2</sub>O-CO<sub>2</sub>: a model for melting of a hydrous mineral with a mixed-volatile fluid. I. Experimental results to 8 kbar. *Geochim. Cosmochim Acta* 37:651-66, 1973.