A revised model for the interpretation of pressure and salinity from fluid inclusions that homogenize by halite disappearance

Lecumberri-Sanchez, Pilar, Steele-MacInnis, Matthew and Bodnar, Robert J.

Department of Geosciences, Virginia Tech, 4044 Derring Hall, Blacksburg, VA, 24061, USA

Fluid inclusions that homogenize by halite disappearance at a temperature higher than the liquid-vapor homogenization temperature are reported in many ore deposits. Becker et al. (2008) developed a model to estimate the pressure at the halite melting temperature based on the temperature of bubble disappearance and T_m(halite) for inclusions that homogenize by halite disappearance. The model is generally consistent with the available experimental data for the liquidus at P above 100 MPa and above 300°C. However, for PTX conditions outside of that range, the model of Becker et al. (2008) yields inconsistent results – for example, if pressure and/or homogenization temperature are below 300°C, the pressure obtained from Becker et al. (2008) for a given and differs significantly from the known halite liquidus (Bodnar, 1994).

In the present study, we extend the model of Becker et al. (2008) to T_h(LV→L) and conditions that are outside of the range of experimental conditions of the earlier model. The model is based on the fact that as fluid inclusions are heated from the temperature of liquid-vapor homogenization to the temperature of halite disappearance, the inclusion must follow an isochoric path. Assuming that no leaking or stretching takes place, this path has to satisfy three main conditions: (1) the volume of the fluid inclusion is constant, (2) the masses of H_2O and NaCl in the inclusion do not change, and (3) the P-T conditions remain on the halite liquidus at all times (liquid is in equilibrium with halite until halite disappears at).

Using these constraints, the PTX evolution of FI along the liquidus has been calculated. For any composition, a and combination produces a single P-X point. The model has been tested for between 100 and 600°C and pressures between the liquid-vapor-halite (L+V+H) three-phase equilibrium curve and 300 MPa. Each - combination produces a single P-X data point.

Pressure P, halite disappearance temperatures and liquid-vapor homogenization temperatures combinations obtained from the mass and volume balance calculations have been regressed to generate an equation that predicts pressure as a function of and (Fig 1). In the same way, composition – - data have been regressed and provide an equation that predicts the inclusion salinity as a function of and (Fig 2).

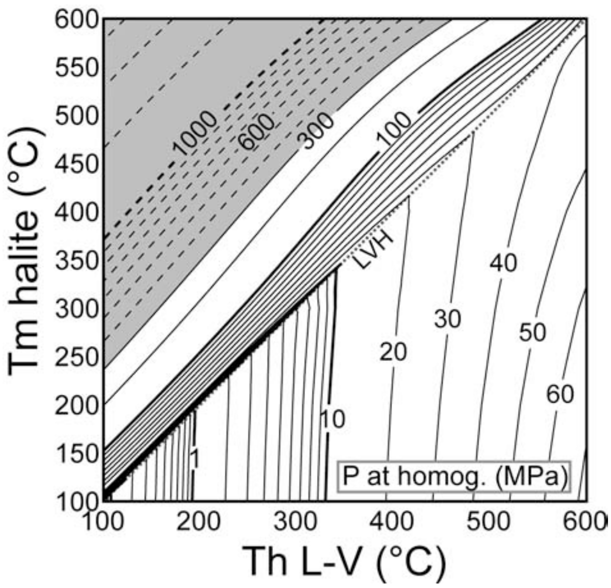

Fig. 1. Isobars predicted by the model as function of –. The grey area is beyond the limits of the data used in this model

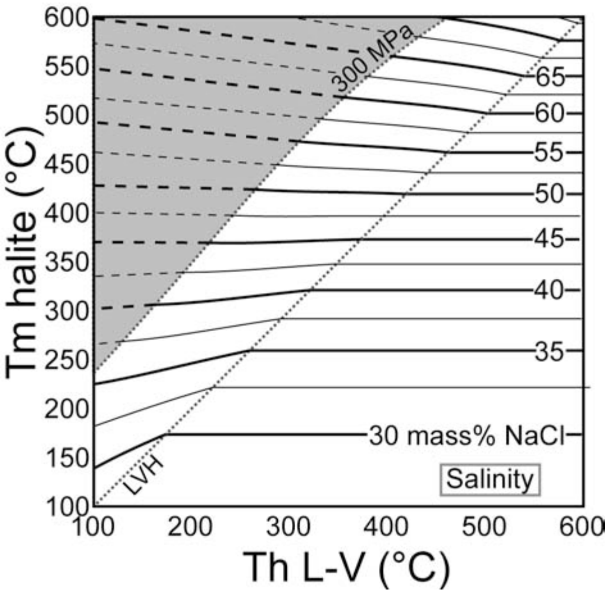

Fig. . Isopleths predicted from T_hLV –$T_m$halite using the model. The grey area is beyond the limits of the data used in this model and has been obtained from extrapolation of the trends below 300 MPa.

The resulting model is consistent with the available experimental data for the halite liquidus (Becker et al., 2008; Bodnar, 1994 and references therein). The equations remove the anomalies present in the previous model of Becker et al. (2008). The equations provide a tool to calculate pressure at homogenization and salinity for fluid inclusions that homogenize by halite disappearance. These equations are valid for inclusions in which is between 100-600°C and pressure at the temperature of halite disappearance is between the L+V+H equilibrium curve and 300 MPa.

REFERENCES

Becker, S.P., Fall, A., Bodnar, R.J. (2008) *Econ.Geol* 103: 539-554.

Bodnar R.J. (1994) *Geochim Cosmochim Acta* 58:1053-1063