

*Journal of Geophysical Research: Solid Earth*

Supporting Information for

**Anhydrite-assisted hydrothermal metal transport to the ocean floor – insights from thermo-hydro-chemical modeling**

Zhikui Guo1, 2, 3\*, Lars H. Rüpke2, Sebastian Fuchs2,4, Karthik Iyer2, Mark D. Hannington2, Chao Chen3, Chunhui Tao1,5\*, Jörg Hasenclever6

1Key Laboratory of Submarine Geosciences, SOA, Second Institute of Oceanography, MNR, Hangzhou 310012, China

2GEOMAR Helmholtz Centre for Ocean Research Kiel, Wischhofstr. 1-3, 24159 Kiel, Germany

3Institute of Geophysics and Geomatics, China University of Geosciences, Wuhan 430074, China

4Federal Institute for Geosciences and Natural Resources, Stilleweg 2, 30566 Hannover, Germany

5School of Oceanography, Shanghai Jiao Tong University, 1954 Huashan Rd., Shanghai 200030, China

6Hamburg University, CEN, Institute of Geophysics, Bundesstr. 55, 20146 Hamburg, Germany

**Contents of this file**

Movie S1

List of additional thermodynamic data

**Additional Supporting Information (Files uploaded separately)**

Caption for Movie S1

Thermodynamic data table

**Introduction**

The movie S1, complementing Figure 6 in the manuscript, shows the evolution of the chimney-like structure and vent temperature. The evolution movie plots vent temperature, saturation of anhydrite and pyrite from 5 to 5000 years with 5 years interval. It was generated by python and matplotlib in mp4 format and with 600 dpi.

We have augmented the Supcrt92 equation-of-state with a number of additional aqueous and mineral species. Those are listed in S\_Table 1 along with the corresponding references.

Movie S1 (Movie1.mp4). Evolution of Chimney-like structure (saturation of anhydrite and pyrite) and maximum vent temperature of model kext=4×10-14 m2 (corresponding to Figure 6 in the manuscript). Two color scales on the right side represent saturation of anhydrite and pyrite respectively, and a color scale inside the axes box shows the vent temperature evolution. A triangle on the top with dynamic color indicating the temperature denotes the horizontal position of vent.

|  |  |  |
| --- | --- | --- |
| **S\_Table 1** List of aqueous and mineral species used in addition to the SUPCRT database. | | |
|
|  | Species | References |
| Aqueous species | |  |
|  | Ag(HS)° | [*Akinfiev and Zotov*, 2001] |
|  | Ag(HS)2- | [*Akinfiev and Zotov*, 2001] |
|  | AgCl° | [*Akinfiev and Zotov*, 2001] |
|  | AgCl2- | [*Akinfiev and Zotov*, 2001] |
|  | AgOH | [*Akinfiev and Zotov*, 2001] |
|  | Ag(OH)2- | [*Akinfiev and Zotov*, 2001] |
|  |  |  |
|  | Au(HS)° | [*Akinfiev and Zotov*, 2010] |
|  | Au(HS)2- | [*Akinfiev and Zotov*, 2010] |
|  | AuCl° | [*Pokrovski et al.*, 2014] |
|  | AuCl2- | [*Pokrovski et al.*, 2014] |
|  | AuOH° | [*Pokrovski et al.*, 2014] |
|  | Au(OH)2- | [*Pokrovski et al.*, 2014] |
|  |  |  |
|  | Cu(HS)° | [*Akinfiev and Zotov*, 2010] |
|  | Cu(HS)2- | [*Akinfiev and Zotov*, 2010] |
|  | CuOH | [*Akinfiev and Zotov*, 2001] |
|  | Cu(OH)2- | [*Akinfiev and Zotov*, 2001] |
|  |  |  |
|  | Zn(HS)2° | [*Akinfiev and Tagirov*, 2014] |
|  | Zn(HS)3- | [*Akinfiev and Tagirov*, 2014] |
|  | ZnCl2° | [*Akinfiev and Tagirov*, 2014] |
|  | ZnCl3- | [*Akinfiev and Tagirov*, 2014] |
|  | ZnCl4- | [*Akinfiev and Tagirov*, 2014] |
|  | Zn(OH)+ | [*Akinfiev and Tagirov*, 2014] |
|  |  |  |
|  | As(OH)3° | [*Perfetti et al.*, 2008] |
|  | AsO(OH)3° | [*Perfetti et al.*, 2008] |
|  |  |  |
| Mineral species | |  |
|  | Tennantite-(Fe) | [*Seal et al.*, 1990] |
|  | Tennantite-(Zn) | [*Seal et al.*, 1990] |
|  | Tetrahedrite-(Fe) | [*Seal et al.*, 1990] |
|  | Tetrahedrite-(Zn) | [*Seal et al.*, 1990] |
|  | Arsenopyrite | [*Perfetti et al.*, 2008] |

**Additional references**

Akinfiev, N. N., & B. R. Tagirov. (2014). Zn in hydrothermal systems: Thermodynamic description of hydroxide, chloride, and hydrosulfide complexes. Geochemistry International, 52(3), 197-214, <https://doi.org/10.1134/s0016702914030021>

Akinfiev, N. N., & A. V. Zotov. (2001). Thermodynamic description of chloride, hydrosulfide, and hydroxo complexes of Ag(I), Cu(I), and Au(I) at temperatures of 25-500 degrees C and pressures of 1-2000 bar. Geochemistry International, 39(10), 990-1006.

Akinfiev, N. N., & A. V. Zotov. (2010). Thermodynamic description of aqueous species in the system Cu-Ag-Au-S-O-H at temperatures of 0-600A degrees C and pressures of 1-3000 bar. Geochemistry International, 48(7), 714-720. <https://doi.org/10.1134/s0016702910070074>

Perfetti, E., R. Thiery, & J. Dubessy. (2008). Equation of state taking into account dipolar interactions and association by hydrogen bonding. I: Application to pure water and hydrogen sulfide. Chemical Geology, 251(1-4), 58-66. <https://doi.org/10.1016/j.chemgeo.2008.02.010>

Pokrovski, G. S., N. N. Akinfiev, A. Y. Borisova, A. V. Zotov, & K. Kouzmanov. (2014). Gold speciation and transport in geological fluids: insights from experiments and physical-chemical modelling. Geological Society, London, Special Publications, 402, 9-70. <https://doi.org/10.1144/SP402.4>

Seal, R. R., E. J. Essene, and W. C. Kelly. (1990). Tetrahedrite and tennantite; evaluation of thermodynamic data and phase equilibria. The Canadian Mineralogist, 28, 725-738.