

Porosity evolution in nickel-iron sulphide minerals during hydrothermal reactions

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Mineral porosity contributes to rock permeability and hence influences the movement of hydrothermal fluids in the crust and the formation of mineral deposits. Porosity is an important factor for in-situ recovery of base metals from ore deposit without traditional mining. Mineral porosity can be generated during fluid-mineral reactions yet the evolution of such reaction-induced porosity is still poorly understood. In this work, we studied porosity evolution during the hydrothermal mineral replacement of nonporous pentlandite $((\text{Fe,Ni})_{9/8}\text{S}_{8/4})$ by porous violarite $((\text{Fe,Ni})_{2/4}\text{S}_{4/4})$, the important reaction responsible for the alteration of pentlandite in natural supergene environments. Using ultra small angle neutron scattering (USANS) [1] and small angle neutron scattering (SANS) [2], we obtained total porosity, pore size distribution, and open-total pore ratio data before and after complete replacement. The majority of these reaction-induced pores are open pores, while the pores below ~10 nm in diameter are mainly closed pores. The evolution of pores in violarite is significant during the replacement process but very slow after the complete replacement. This quantitative examination of reaction-induced porosity in violarite has increased our understanding of porosity evolution and how it contributes to the mineralisation in and around nickel deposits. In addition, it has increased our understanding of the reactivity, during hydrometallurgical processing, of nickel iron sulphide minerals.

[1] C. Rehm, L.d. Campo, A. Brûlé, F. Darmann, F. Bartsch, A. Berry, Design and performance of the variable-wavelength Bonse–Hart ultra-small-angle neutron scattering diffractometer KOOK-ABURRA at ANSTO, *Journal of Applied Crystallography*, 51 (2018) 1-8.

[2] A. Sokolova, A.E. Whitten, L. de Campo, J. Christoforidis, A. Eltobaji, J. Barnes, F. Darmann, A. Berry, Performance and characteristics of the BILBY time-of-flight small-angle neutron scattering instrument, *Journal of Applied Crystallography*, 52 (2019).

Level of Expertise

Student

Do you wish to take part in the poster slam

Yes

Travel Funding

Yes

Speakers Gender

Male

Primary authors: KARTAL, Muhammet (Murdoch University); Dr XIA, Fang (Murdoch University)

Co-authors: Mr ADEGOKE, Idowu Abiodun (Murdoch University); Dr RALPH, David (Murdoch University); Dr MATA, Jitendra (ANSTO); Dr SOKOLOVA, Anna (ANSTO)

Presenter: KARTAL, Muhammet (Murdoch University)

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