LA-ICP-MS evidence for Au-Cu coupling in modern sea-floor massive sulphides, Kolumbo arc-volcano (Santorini), Greece

E. ZYGOURI[1], S.P. KILIAS[1*], T. ZACK[2], I. PITCAIRN[3], E. CHI FRU[4], P. NOMIKOU[1], A. ARGYRAKI[1], M. IVARSSON[5], P. POLYMENAKOU[6], AND S. CAREY[7]

[1] National and Kapodistrian University of Athens, Athens 15784, Greece (*correspondence: kilias@geol.uoa.gr)
[2] University of Gothenburg, SE-405 30 Gothenburg, Sweden Stockholm, Sweden (thomas.zack@gu.se)
[3] Stockholm University, Stockholm 10691, Sweden
[4] Cardiff University, Cardiff, CF10 3AT, UK
[5] Swedish Museum of Natural History, SE-104 05
[6] Hellenic Centre for Marine Research, Heraklion, Crete 71003, Greece (polymen@hcmr.gr)
[7] University of Rhode Island, Rhode Island 02882, USA

Pyrite from ancient hydrothermal ore deposits commonly shows spatial decoupling between Au, Cu and As contents, however investigations into this process in modern sea-floor massive sulphides is lacking [1, 2]. LA-ICP-MS minor metal(loid) analysis of early primary colloform pyrite (Py1), recrystallized sub- to euhedral pyrite (Py2) and associated sulphides/sulphosalts from Kolumbo shallow-submarine arc-volcano, show that Py1 contains up to 58 ppm Au, 2 wt% Cu and 9071 ppm As, whereas Py2 is characterized by lower concentrations (up to 24 ppm Au, 1.3 wt% Cu, and 4297 ppm As). LA spectra confirm that concentrations of Au and Cu are mainly related to structurally bound Au and Cu in Py1, and submicron-sized Au-bearing and Cu-sulfide particles in Py2, whereas As is in solid solution in both. Increasing fluid temperature and Py1 to Py2 recrystallization, lead to decreasing solubility of Au, Cu and As in pyrite, resulting in partial expulsion of As from pyrite, and concomitantly: (1) an increase in the nucleation of Au and Cu-sulfide sub-micron particles in Py2 [positive correspondence between Cu and Au (R^2 = 0.70), and Cu and As (R^2 = 0.68) concentrations]; and (2) expulsion of Au, and Cu, from pyrite, and incorporation in sulphide phases (galena: up to 60 ppm Au; Pb-Sb-sulfosalt: 87 ppm Au; As-sulfide: 171 ppm Au) and late chalcopyrite, respectively.

[1] Tardani *et al*. (2017) *Geochim*. *Cosmochim*. *Acta* doi: http://dx.doi.org/10.1016/j.gca.2017.01.044 [2] Reich *et al*. (2013) *Geochim*. *Cosmochim*. *Acta* **104**, *42–62*.