Isotopic and compositional characterization of sulphur gases and condensates formed after heating sulphur-containing solids: Implications for sedimentary records

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Our understanding of the movement of sulphur gases in sedimentary systems is hampered by the lack of good methods to monitor diagenetic processes. We developed an experimental system comprised of a modified furnace system that interfaces with a X-ray Absorption Near Edge Structure (XANES) spectroscopy beamline and quadrupole mass spectrometer (QMS) to evaluate the composition of sulphur gases produced during heating of sulphur-bearing compounds (e.g., elemental sulphur, pyrite, cysteine). Gas compositions from the solids were distinct, and gas species compositions changed when solids were heated to different maximum temperatures. The results provide strong evidence that sulphur gases, as well as solids, change compositionally during diagenesis, even at low (<100° C) temperatures. When gases cool after each experiment, XANES spectra of solid condensates reveal that sulphur species were distinct from the precursor solids. X-ray absorption spectra are not isotope sensitive, so in combination with QMS for the gases, we also measured condensate isotopic compositions using conventional mass spectrometry. Isotopic values for $\delta^{34}S$ revealed that the condensates became isotopically lighter compared to the starting material, and depending on the maximum temperature applied during an experiment. Our study reveals dynamic processes between volatile and condensed sulphur compounds that could resolve misleading isotopic records in sedimentary rocks.