Pyrite development within volcanic hosted petroleum reservoirs

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Within petroleum systems pyrite framboids are commonly found in the organic-rich source rocks, where they are interpreted as having formed during diagenesis, through biogenic reduction of pore-water sulphate. In the course of the study of a sequence of volcanic and sedimentary rocks of the Early Cretaceous back-arc basin of central Chile, I have documented the presence of abundant pyrite framboids associated dominantly with a degraded petroleum reservoir. The pyrite-rich petroleum, now bitumen, occupies primary and fracture porosity in volcanic reservoir rocks, rather than in the underlying sedimentary source rocks.

The petrology of the rocks and sulphur isotope data indicate that the pyrite framboids developed within the petroleum reservoir as a result of sub-surface biodegradation

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of the, then migrating and accumulating, petroleum, circulating through primary and secondary porosity and basinal normal (probably growth) faults. It is suggested that the Fe-rich andesite volcanic reservoir rocks supplied Fe, which reacted with bacterially generated H_2S from sulphate within the migrating petroleum fluids. This reduction led to the precipitation of pyrite (with very minor sphalerite and chalcopyrite) within primary and secondary porosity of the reservoir rocks. The solidified petroleum (bitumen) still contains up to 2 wt. % sulphur.

Therefore, bacterial degradation of petroleum reservoirs can lead to the development of an authigenic assemblage of metal sulphides within the reservoir, thus fouling of the reservoir, and imparting it significantly different physical and chemical properties. The Fe-rich chemical character of the reservoir rocks may be a factor in determining the growth of pyrite.