Pressure-temperature diagenesis of Fe minerals and biomass produces hematite, siderite and magnetite as present in Banded Iron Formations

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The reconstruction of microbial life in ancient sedimentary deposits is complicated by the influence of temperature and pressure during diagenesis and metamorphism. While minerals and persistent organic molecules may be evident in ancient rock formations such as Banded Iron Formations (BIFs), the specific primary minerals, their (trans-)formation mechanisms and proposed microbial processes involved are not certain. Understanding the transformation of biogenic iron minerals is the key to constraining models of BIF deposition that occurred between 3.8-0.8 billion years ago [1]. Thermal and barometric transformations of Fe (III) minerals associated with organic carbon (biomass, e.g. microbial cells) have not yet been systematically tested in laboratory experiments. Here, we present experimental results of mineral transformations of Fe (III) hydroxide and organic matter (glucose as a proxy for biomass) in gold capsules at elevated pressures and temperatures. Iron speciation and mineralogical analysis show the conversion of ferrihydrite [Fe $(OH)_3$, ferric hydroxide] into hematite ($Fe_2^{III}O_3$), magnetite ($Fe^{II}Fe_2^{III}O_4$), and siderite ($Fe^{II}CO_3$). Our results suggest that the joint precipitation of biomass with primary Fe (III) hydroxides followed by pressure/temperature diagenesis produces minerals found in BIFs today. Moreover, this study shows that siderite and magnetite form, i.e. Fe (III) is partially reduced, under diagenetic conditions decoupled from conditions in the ocean/atmosphere. The experimental system presented herein offers a means to bridge the gap between geological evidence from the field and laboratory experiments with modern microbe analogues.

[1] Koehler *et al*. (2010) Role of microorganisms in Banded Iron Formations. *Geomicrobiology, Molecular & Environmental Perspective*. Larry Barton, Martin Mandl & Alexander Loy (Editors) 485p.

Source rock-oil correlation in the Sinop Basin (Northern Turkey)

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Lower Cretaceous aged Çağlayan Formation is exposed in the Sinop Basin consists of black coloured claystone, siltstone, shale and marl, and has source rock characteristics. An oil seep from Çağlayan Formation is located in the Ekinveren region of the Sinop Basin.

The average total organic carbon (TOC) values of the shale samples from the Çağlayan Formation in the Ekinveren and the Bürnük areas are 1.48, 1.26 % and HI values are 190, 244 mg HC/g TOC, respectively. The potential yield values of the sample from the Ekinveren and the Bürnük are >2 mg HC/g rock and these potential yield values indicate fair hydrocarbon potential for the Çağlayan Formation.

The unimodal n-alkane distribution with lower carbon number dominant is observed in the gas chromatograms of the shale samples from the Çağlayan Formation in the Ekinveren and the Bürnük locations. Low TAR, $(C_{19}+C_{20})/C_{23}$ tricyclic terpane ratios and type II kerogen content indicate that the shale samples from the Çağlayan Formation comprise dominantly marine organic matter. Pr/Ph ratios for the Ekinveren and the Bürnük shale samples are 1.39 and 0.89, respectively.

Average T_{max} values for the Ekinveren and the Bürnük locations are 429 and 433°C, respectively. According to T_{max} data, Çağlayan Formation has immature-early mature characteristics in the Ekinveren location and early mature-mature characteristics in the Bürnük location. CPI values, isoprenoid/n-alkane ratio, 20S/(20S+20R) and ββ/(ββ+αα) C_{29} sterane, 22S/(22S+22R) C_{32} homohopane ratios for the Ekinveren and Bürnük shale show that Bürnük shale are more mature than those of the Ekinveren shale.

A large UCM and n-alkanes, isoprenoids that were recorded in low amount in gas chromatogram for oil sample from the Ekinveren seep indicate that the Ekinveren oil seep were heavily biodegraded. Similar tricyclic terpane, C_{24} tetracyclic terpan, norhopane, hopane and homohopane distributions were recorded in m/z 191 and m/z 127 mass chromatograms of samples from the Çağlayan Formation and the Ekinveren oil seep. Higher diasterane and pregnane content is typical for oil and shale samples. C_{27}, C_{28}, C_{29} sterane distribution for oil and shale samples is similar. According to biomarker data, Çağlayan Formation and Ekinveren oil seep are well correlated to each other.