ASSESSING HYDROCARBON BIOMARKERS RELEASED FROM ARCHEAN ROCKS AFTER HYDROCHLORIC ACID TREATMENT (BITUMEN II)

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Introduction

Organic solvent extracts (Bitumen I) of ultra-clean drill core samples of metamarls and metapelites of Archean age (ca. 2.55–2.63 billion years) from the Pilbara Craton, Western Australia (Agouron Institute Drilling Program 2012), are devoid of hydrocarbon biomarkers such as hopanes and steranes, except for traces attributed to laboratory contamination. The only detected organic compounds in Bitumen I are highly mature *n*-alkanes, diamondoids and aromatic hydrocarbons (French et al., 2015).

Results

We found biomarkers in organic solvent extracts after the same rocks were decarbonated with hydrochloric acid (Bitumen II). The detected biomarkers include various hopanes, steranes and their diagenetic products. The concentrations reach ~130 pg/g while the highest concentration of biomarkers in Bitumen I reach only ~8 pg/g (Figure 1). Maturity related indices and calculated vitrinite reflectances based on diamondoids and aromatic hydrocarbons show that Bitumen II is generally of lower thermal maturity than Bitumen I. There are three possible explanations for the origin of the detected biomarkers. Firstly, the described biomarkers in Bitumen II could have been protected and thus have been preserved in the sedimentary carbonate matrices against the prevalent metamorphic conditions (greenschist facies; Peters et al., 2016), which would be consistent with the thermal maturity differences between Bitumen I and II. Secondly, the biomarkers in Bitumen II could have been derived from less mature carbonate veins of a younger origin (Peters et al., 2016, Peters and George, 2018). Thirdly, the Bitumen II extraction procedure causes a higher degree of contamination than the Bitumen I extraction. The last explanation is consistent with the highest biomarker concentration being found in a volcanic rock blank.

Conclusions

We conclude that the biomarkers found in Bitumen II may represent a mixed signal coming from sedimentary carbonates, later carbonate veins, and contaminants. It is not possible in our current study to distinguish between these three sources after bulk-solvent extraction. The sequential hydrocarbon extraction method has the potential to shed light on the ancient biosphere through previously inaccessible preserved organic matter (Bitumen II), but our results urge a re-examination of the extraction protocol for a stricter contamination control, particularly if it is applied for life signatures in the early Earth.

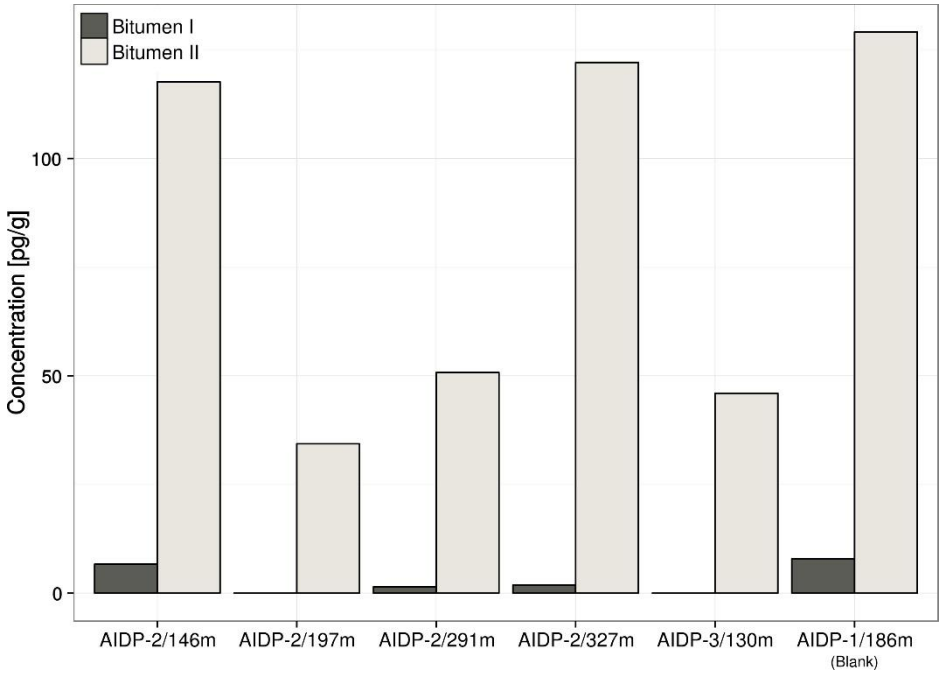

Figure 1 *Summarised total biomarker concentrations in Bitumen I and II of samples from the Agouron Institute Drilling Program (AIDP).*

References

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