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Arsenic(III) methylation in betaine–nontronite clay–water suspensions under

environmental conditions

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a b s t r a c t

This paper reports arsenic methylation in betaine–nontronite clay–water suspensions under environmental

conditions. Two nontronites (<0.05 mm), NAu-1 (green color, Al-enriched) and NAu-2 (brown

color, Al-poor, contains tetrahedral Fe) from Uley Mine - South Australia were selected for this study.

Betaine (pKa = 1.83) was selected as methyl donor. The reaction between 5 g L−1 clay, 20ppm As(III),

and 0.4M betaine at 7≤pH0 ≤9 under anoxic conditions was studied. The presence of nontronite clays

were found to favor As(III) conversion to monomethylarsenic (MMA). Arsenic conversion was found

to be as high as 50.2 ngMMA/ng As(III)0. Conversion of As was found to be more quantitative in the

presence of NAu-2 ((Na0.72) [Si7.55 Al0.16Fe0.29][Al0.34 Fe3.54 Mg0.05] O20(OH)4) than NAu-1 ((Na1.05) [Si6.98

Al0.95Fe0.07][Al0.36 Fe3.61 Mg0.04] O20(OH)4). The inherent negative charge at the nontronite tetrahedral

layer stabilizes positively charged organic intermediate-reaction species, thereby leading to decreases in

the overall methylation activation energy. The outcome of this work shows that nontronite clays catalyze

As methylation to MMA via non-enzymatic pathway(s) under environmental conditions. Contents lists available at ScienceDirect

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