

Hydrocarbon Sources at a Site of Active Continental Serpentinization: The Cedars, California, USA

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The Cedars, located near Cazadero in Northern California, USA, is a partially serpentinized peridotite wedge that is cradled by marine sediments of the Franciscan Subduction Complex (FSC). The peridotite wedge is host to a number of springs associated with continental serpentinization. These ultra-basic reducing springs contain CH₄, straight and cyclic alkanes and aromatic compounds. Active serpentinization and the geologic setting of The Cedars create a unique system where both microbial and non microbial hydrocarbon production is possible. The depleted $\delta^{13}\text{C}_{\text{CH}_4}$ values (-57 to -67 ‰) measured at The Cedars are within range of microbial methanogenesis, and on a CD diagram ($\delta^2\text{H}_{\text{CH}_4}$ vs $\delta^{13}\text{C}_{\text{CH}_4}$) plot within the microbial acetate fermentation region. In support of the CD data, a microcosm study using labelled substrates showed the potential for acetotrophic methanogenesis, and a metagenomic study also indicated the presence of methanogens in the springs. Therefore a microbial contribution to the CH₄ at The Cedars cannot be discounted. However, the geological context, molecular concentration and isotopic composition of other hydrocarbons, and mixing models suggest a secondary non-microbial source of hydrocarbons (e.g. a thermogenic source from the underlying marine sediments of the FSC).