

Diffuse CO₂ Degassing to Study Blind Geothermal Systems: The Acoculco, Puebla (Mexico) Case Study

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Abstract : The Acoculco caldera located in Puebla (Mexico) has been preliminary identified as a blind hot-dry rock geothermal system. Two drilled wells suggest the existence of high temperatures >300°C and non-conventional tools are been applied to study this system. A comprehensive survey of soil-gas (CO₂) flux measurements (1,500 sites) was carried out during the dry seasons over almost two years (2015 and 2016). Isotopic analyses of $\delta^{13}\text{CCO}_2$ were performed to discriminate the origin source of the CO₂ fluxes. The soil CO₂ flux measurements were made in situ by the accumulation chamber method, whereas gas samples for $\delta^{13}\text{CCO}_2$ were selectively collected from the accumulation chamber with evacuated gas vials via a septum. Two anomalous geothermal zones were identified as a result of these campaigns: Los Azufres (19°55'29.4" N; 98°08'39.9" W; 2,839 masl) and Alcaparrosa (19°55'20.6" N; 98°08'38.3" W; 2,845 masl). To elucidate the origin of the C in soil CO₂ fluxes, the isotopic signature of $\delta^{13}\text{C}$ was used. Graphical Statistical Analysis (GSA) and a three end-member mixing diagram were used to corroborate the presence of distinctive statistical samples, and trends for the diffuse gas fluxes. Spatial and temporal distributions of the CO₂ fluxes were studied. High CO₂ emission rates up to 38,217 g/m²/d and 33,706 g/m²/d were measured for the Los Azufres and Alcaparrosa respectively; whereas the $\delta^{13}\text{C}$ signatures showed values ranging from -3.4 to -5.5 ‰ for both zones, confirming their magmatic origin. This study has provided a valuable framework to set the direction of further exploration campaigns in the Acoculco caldera. Acknowledgements: The authors acknowledge the funding received from CeMIE-Geo P09 project (SENER-CONACyT).

Keywords : accumulation chamber method, carbon dioxide, diffusive degassing, geothermal exploration

Conference Title : ICGG 2017 : International Conference on Gas Geochemistry

Conference Location : Rome, Italy

Conference Dates : September 18-19, 2017