Sourcing greenhouse gases in karst systems

Fernandez-Cortes, A.[1], Cuezva, S.[2,3], Pérez-López, R.[4], Mattey, DP.[5], Hernández-Vicente, I.[2], Bourges, F.[6], Fisher, R.[5], Cañaveras, JC.[7], Calaforra, JM.[1], Sanchez-Moral, S.[2]

[1] *Department of Biology and Geology, University of Almeria, 04120 Almeria, Spain*

[2] *Department of Geology, National Museum of Natural Sciences (MNCN-CSIC), 28006 Madrid, Spain*

[3] *Geomnia Natural Resources SLNE, 28003 Madrid, Spain*

[4] *IGME, Instituto Geológico y Minero de España, 28003 Madrid, Spain*

[5] *Department of Earth Sciences, Royal Holloway, University of London, Egham, Surrey TW20 0EX, UK*

[6] *GEconseil, 30 rue de la République, 09200 St Girons, France*

[7] *Department of Environment and Earth Sciences, University of Alicante, Alicante, Spain*

Abstract

Recent studies have demonstrated that caves may act as significant reservoir of CO_2-gas on an annual scale and may be acting as sinks for atmospheric CH_4 on a daily scale, which provide evidence that the subterranean atmosphere of karst systems may play a key role in regulating greenhouse gases in the atmosphere. In this study, we have measured CO_2 and CH_4 variability and carbon isotope composition of subterranean air in karst environments. The cave sites cover a spectrum of local climates (oceanic and continental), bedrock lithology, cave microclimatic conditions, ventilation pattern, geomorphological and speleogenesis types (epigenic and hypogenic caves). The results of this study indicate that the increase in the residence time of atmospheric-derived air in the subterranean environment provokes CO_2 accumulation and a more effective CH_4 consumption, depleting CH_4 concentrations almost to zero throughout an annual cycle. The potential mechanisms involved on the CO_2 dynamic and prevailing depletion of either atmospheric or geogenic-derived CH_4 in subterranean atmospheres are also discussed. Carbon isotopic data show that the methane dynamics of subterranean environments on karst is consistent with atmospheric CH_4 oxidation by methanotrophs and, in some cave locations, there are some evidenced of geogenic and biogenic methane sources that are highly diluted with cave air with sub-atmospheric CH_4 concentrations.

Keywords: carbon dioxide, methane, caves, carbon isotopes, karst, subsoil.