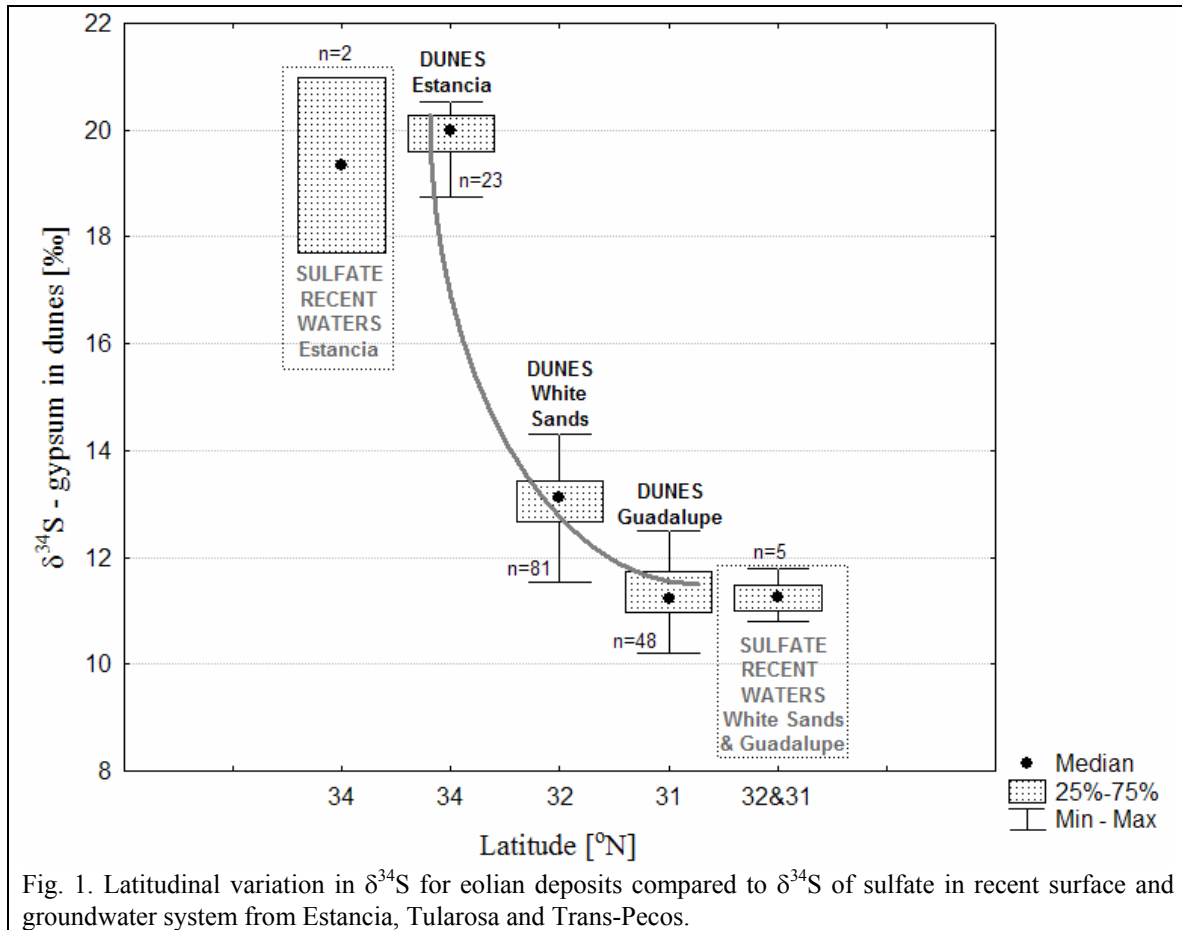


SULFUR CYCLING IN GYPSUM DUNES FROM NEW MEXICO – TERRESTRIAL ANALOGS TO SULFATE-EOLIAN DEPOSITION AND EARLY DIAGENESIS ON MARS. PRELIMINARY RESULTS.

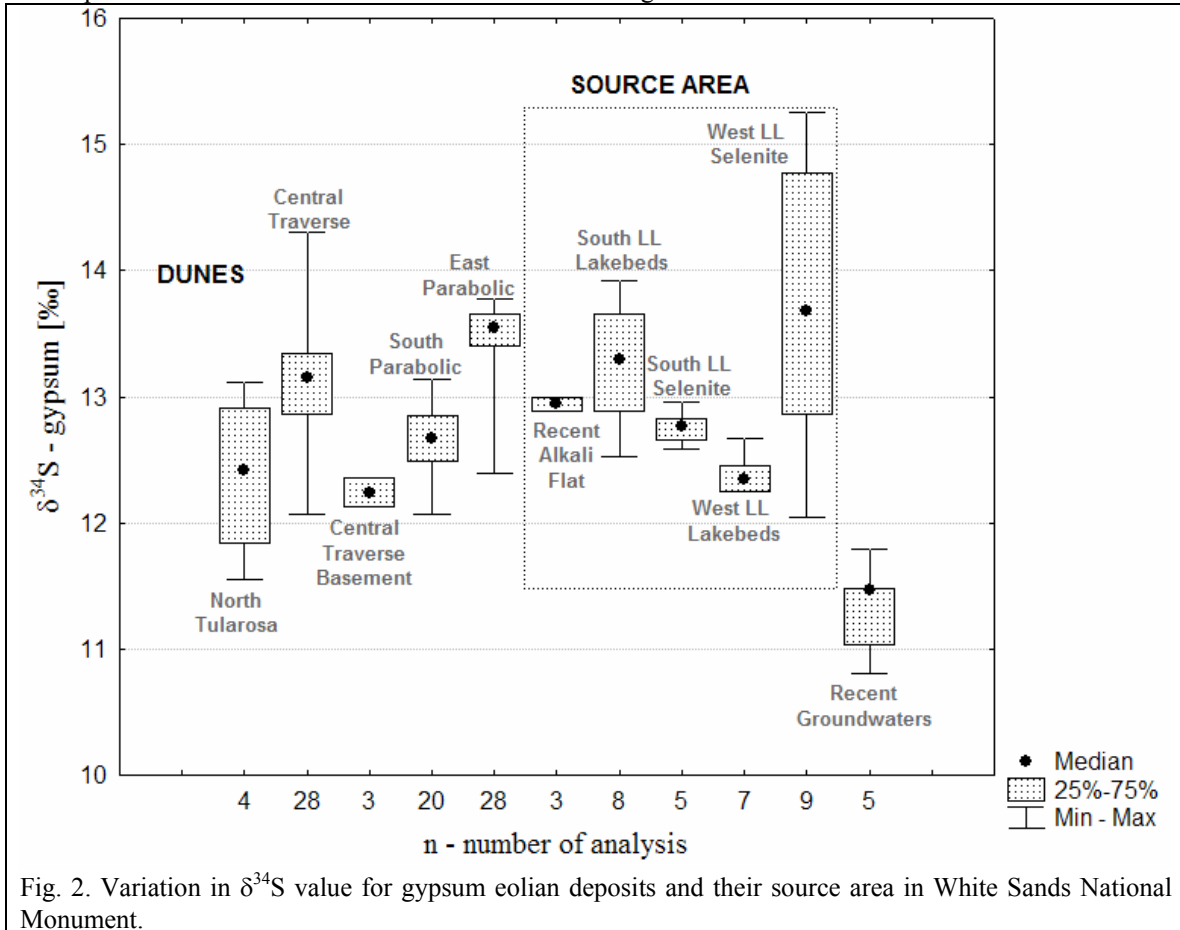
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Results and discussion:

SULFUR SOURCE: the main sulfur reservoir for gypsum deposits in the studied Salt Basins consist mainly of Permian evaporites extending from Central New Mexico to North Mexico. Dissolution of these Permian evaporites (average $\delta^{34}\text{S} = 11.7 \text{ ‰}$) significantly influences a high-sulfate content and its $\delta^{34}\text{S}$ value in surface and groundwaters of that region. A general increase of $\delta^{34}\text{S}$ values in gypsum dunes with increasing latitude (Fig. 1) evidences that bacterial sulfate reduction might have controlled the sulfate isotope composition of evaporative crusts. That process is still common in Estancia and easily recognized in recent groundwater playa lakes systems (Fig. 1). We propose that the different latitudinal localizations of Estancia, Tularosa and Trans-Pecos have involved a diverse microbial community and organic matter input related to varied climate conditions during last glaciation in the North America.



DUNES FORMATION: A detailed spatial analysis of $\delta^{34}\text{S}$ in dunes taken from White Sands National Monument and the selected points north of TB has shown wide and neat variations similar to the source area, consisting of lakebeds and large selenite crystals exposed in the southern and western edges of Lake Lucero (Fig. 2). Important differences in $\delta^{34}\text{S}$ of gypsum dunes from different localities suggest that they have formed from different evaporative crust during several eolian episodes due to variation in aridity and the exposure rates of the source area for surface weathering.



CLIMATE FINGERPRINT: Good agreement between δD values in gypsum dunes and δD values of modern precipitation in New Mexico and East Chihuahua shows that eolian deposits preserve information about hydrogen isotope composition of water/fluids as a source solution for formation of evaporative crust from which the dunes may form (Fig. 3).

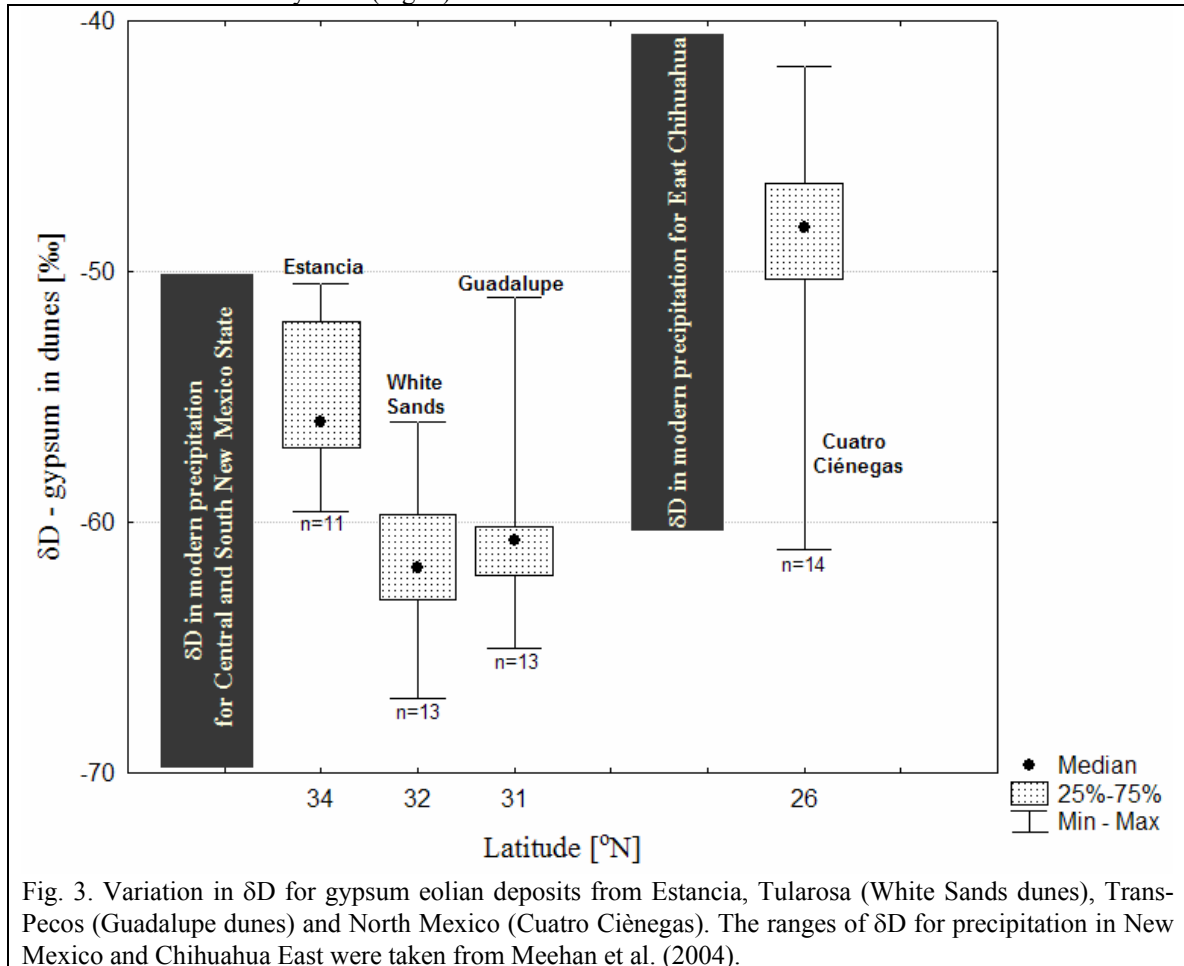


Fig. 3. Variation in δD for gypsum eolian deposits from Estancia, Tularosa (White Sands dunes), Trans-Pecos (Guadalupe dunes) and North Mexico (Cuatro Ciènegas). The ranges of δD for precipitation in New Mexico and Chihuahua East were taken from Meehan et al. (2004).

MAGMATIC/HYDROTHERMAL SIGNATURE: the sulfur isotope analysis of individual lenticular gypsum grains and aggregates, carried out along 6 m long profile of lakebeds exposed north of Tularosa, show excursions to negative values; in Event 1, up to -1.08 ‰, occurred around 30,000 years ago and Event 2, up to 0.85 ‰, around 20,000 years ago (Fig. 4). Both, bacterial oxidation and/or magmatic/hydrothermal input may cause the negative shift in $\delta^{34}\text{S}$ value.

A recent magmatic input of H_2S may be traced in the northern part of the Rio Grande Rift. The 3-mile long Sulfur Creek in Valles Caldera is fed by acid-sulfate hot springs originates from exhalation of H_2S -rich gases and differs importantly in $\delta^{34}\text{S}(\text{SO}_4)$ value, from 2.25 to 2.65 ‰, compared to other hot springs that preserve the signature of Permian evaporates dissolution ($\delta^{34}\text{S}$ from 8.87 to 13.14 ‰).

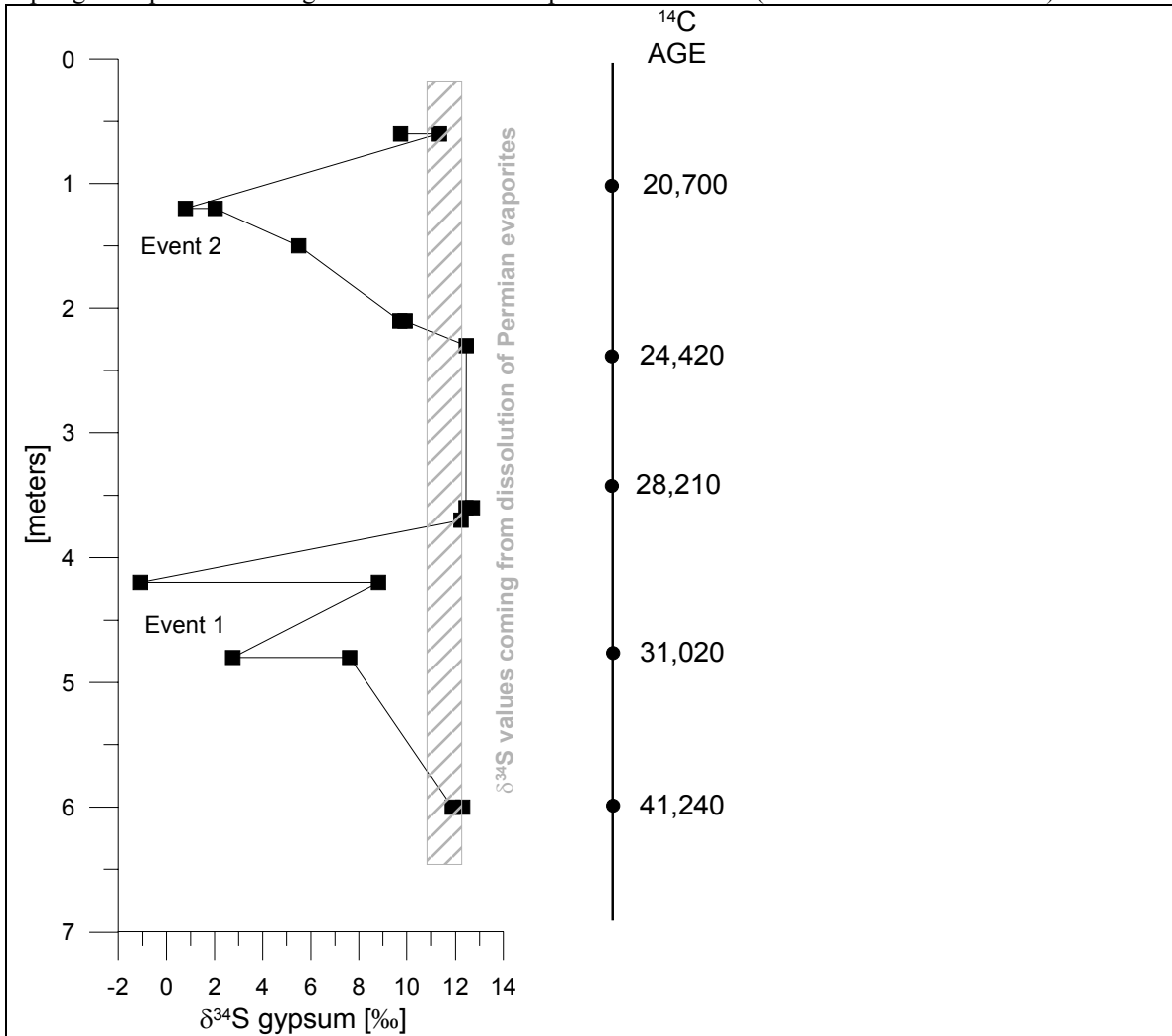


Fig. 4. Variation in $\delta^{34}\text{S}$ value for gypsum lake sediments from the North Tularosa Basin. The range of $\delta^{34}\text{S}$ value for Permian evaporates was taken from Leslie et al. (1997). Sediment samples and their age were provided by Bruce Allen working on unrelated project in the Tularosa Basin.

CONCLUSIONS: Our preliminary results showing that sulfate eolian deposits from the Salt Basins associated with the Rio Grande Rift evolution are competitive places for astrobiological constrains, climate and sulfur studies in order to better understand Martian sulfur cycle and climate evolution.

Acknowledgments: This study was supported by the NASA Astrobiology Institute team award directed by L.M. Pratt. Sincerest thanks are due to Bruce Allen for recommending field sites and providing gypsum sediments from the North Tularosa Basin, to the National Park Service for allowing access to the White

Sands National Monument (WSNM) and Guadalupe Mountains National Park (GMNP), to David Bustos for field assistance in WSNM, to Fred Armstrong and Gordon Bell for field assistance in GMNP and to Marta Kurasiewicz for helping in preparation of some samples for sulfur isotope analysis.

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Leslie et al. (1997) *Sedimentary Geology*, 110, 223-235, Meehan et al. (2004) *Isotopes in Environmental and Health Studies*, 40, 291-300.