

Slimy playas and sliding rocks in the Basin and Range Province

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Summary

For many years, the mechanism which drives the movement of sliding rocks across playa surfaces has been hotly debated. New evidence from a study of fourteen playas strongly suggests that there exists a correlation between the presence of sliding rocks and the cyanobacterium *Microcoleus* sp. The gelatinous ooze produced by *Microcoleus* is inferred to reduce the coefficient of friction to a value that would allow wind-propelled motion of rocks to occur on a wet playa surface.

Introduction

The mystery of the sliding rocks on Racetrack Playa has puzzled scientists and delighted the public since the 1950's. Located in California's Death Valley National Park, the Racetrack Playa is an ephemeral lake which is host to a rare phenomenon: at any given time there may be up to 160 meandering trails carved into the flat, desiccated playa surface, which are tens to hundreds of meters long (Messina, 2000). At the ends of many of these trails lay rocks, which have originated from a bedrock slope bordering the playa (fig. 1). The rocks have clearly moved these long distances, carving out trails behind them in the muddy substrate.

The intrigue surrounding the mysterious movement arises from the lack of eyewitnesses. This has led to debate regarding the mechanism which drives the sliding rocks. The general consensus is that the playa surface must be wet after a storm event, and therefore slick because of the high clay content, and that wind must be involved. It is after this point though, that two main schools of thought diverge. The first basic hypothesis is that wind alone can propel the rocks (Sharp and Carey, 1976; Eriksson et al., 1996; Messina, 2000). The second is that the rocks become entrapped in thin sheets of ice and are dragged over the playa surface as the floating sheets are blown around (Reid et al., 1995). While it is the most famous and best studied location, Racetrack Playa is not the only venue of the sliding rock phenomenon. An additional eight playas are cited in the literature as hosting sliding rocks (Sharp and Carey, 1976; Eriksson et al., 1996), and we introduce here a previously unknown 'slider playa'.

In order to further understand what variables affect the movement of rocks across playa surfaces, a suite of fourteen playas located within the Basin and Range Province of the southwestern United States were compared in the first study of its kind. Samples collected from

these playas, five of which are known to have sliding rocks and nine which have no documented cases, underwent various tests to determine if there existed a common factor between all playas with sliding rocks. Grain size and mineralogy of the playa sediments as well as the effect of surrounding topography on wind patterns were analyzed. The results showed that topography and mineralogy are minor-to-insignificant factors, while grain size analysis showed a very strong correlation between a large abundance of grains less than 0.50 μ m and the presence of sliding rocks on playas (fig. 2).

The most significant discovery which resulted from this study, however, was the recognition of the apparent influence of organic matter on rocks sliding. The cyanobacterium *Microcoleus* sp. was observed to grow in significant quantities on all samples collected from the surfaces of playas with sliding rocks, when the samples were covered in water (fig. 4). Its absence on all but two of the playas *without* sliding rocks strongly suggests that this fast-growing, hardy cyanobacterium plays an important role in this phenomenon.

Microcoleus sp. is a cyanobacterial mat which is found in a variety of environments, often harsh and inhospitable (Whitton and Potts, 2002). Able to go dormant for months at a time during the dry season, this organism has high growth rates when the conditions become favourable (Fagerstrom, 1967). This genus forms a dense, tangled mat and produces a gelatinous sheath. These qualities- the ability to go dormant during the dry season, high growth rates, and the production of a gelatinous ooze- coupled with the fact it was found to grow on all sliding rock-bearing playas, strongly suggests that cyanobacterial growth is a significant factor in determining a playa's "slider status".

The results from this study lead us to infer that the gelatinous mat produced by *Microcoleus* sp. would reduce the coefficient of friction to a value which would allow for rocks to slide across a playa surface by propulsion of wind alone.

References

- Eriksson P.G., Förtsch E.B., Snyman C.P., Lingenfelder J.H., Beukes B.E., Cloete W. 1996. Wind-blown rocks and trails on a dry lake bed: An alternate hypothesis. *Journal of Sedimentary Research*, vol. 66: pp. 36-38.
- Fagerstrom, J.A. 1967. Development, flotation, and transportation of mud crusts- neglected factors in sedimentology. *Journal of Sedimentary Petrology*, vol.37: pp. 73-79.
- Messina, P., Stoffer, P. 2000. Terrain analysis of the Racetrack Basin and the sliding rocks of Death Valley. *Geomorphology*, vol. 35: pp. 253-265.
- Reid, J.B., Bucklin, E.P., Copenagle, L., Kidder, J., Pack, S., Polissar, P., Williams, M. 1995. Sliding rocks on the Racetrack, Death Valley: What makes them move? *Geology*, vol. 23: pp. 819-822.
- Sharp, R.P., Carey, D.L. 1976. Sliding Stones, Racetrack Playa, California. *Geological Society of America Bulletin*, vol. 87: pp. 1704-1717.
- Whitton, B., Potts, M. 2002. *The ecology of cyanobacteria: their diversity in time and space*. Kluwer Academic, Boston, USA.



Figure 1: One of the many sliding rocks on Racetrack Playa, Death Valley National Park, in the winter of 2009. The rock is approximately 25cm across.

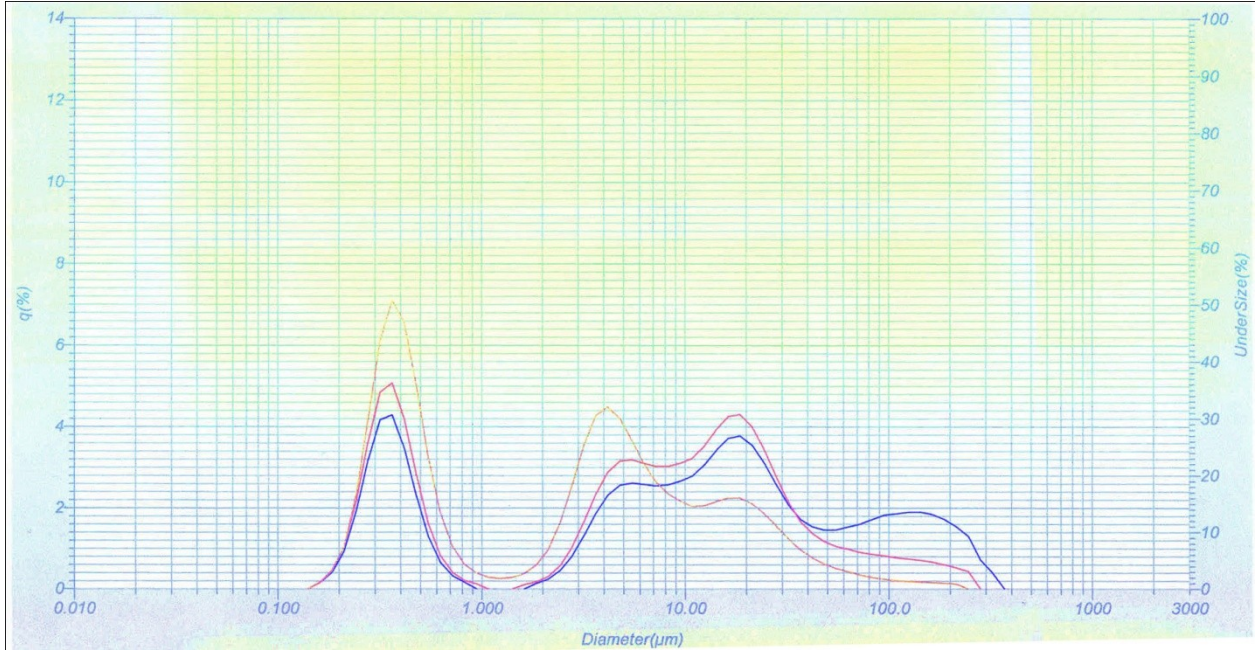


Figure 2: Three trials of grain size analysis of Racetrack Playa sediment, showing a distribution that is typical of sediments collected from other playas with sliding rocks.



Figure 3: Elongate, narrow and segmented nature of *Microcoleus*, microscopic view.

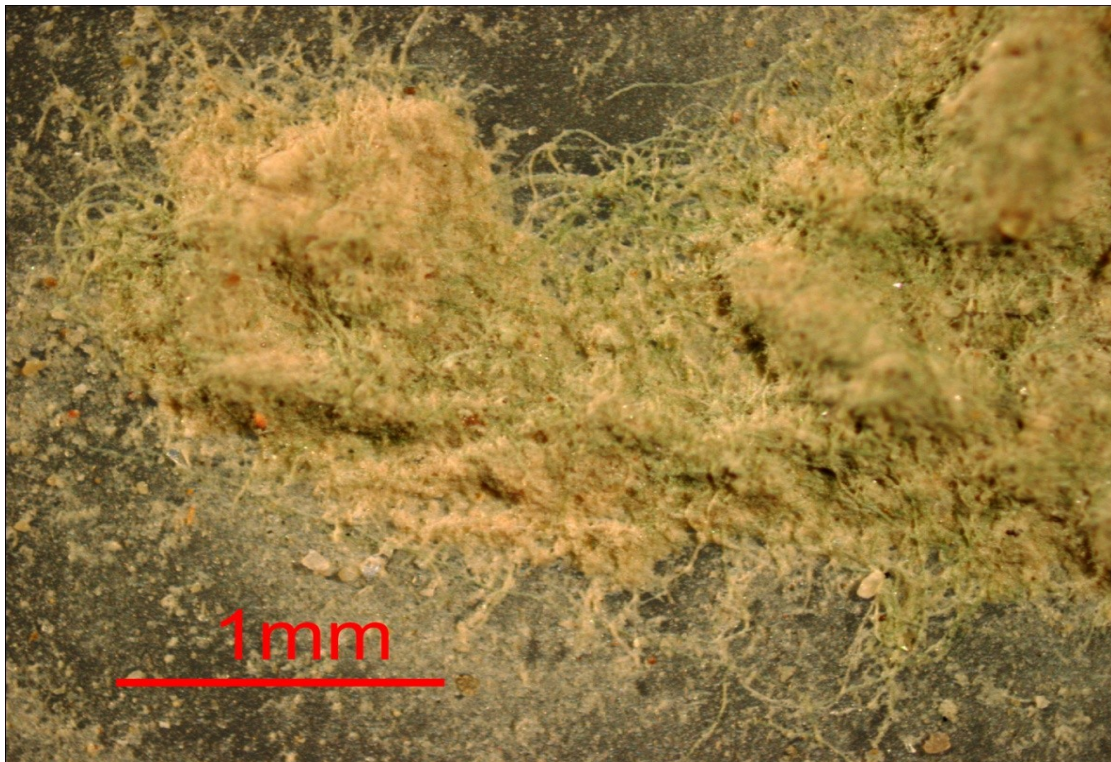


Figure 4: Matted growth form of *Microcoleus* growing on a sample of sediment from Racetrack Playa.