National Aeronautics and Space Administration

Relating a Southern California Moving Mudpot to Tectonic Processes

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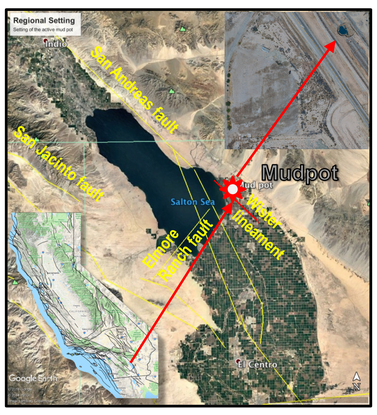
Program: Spontaneous

Project Objective:

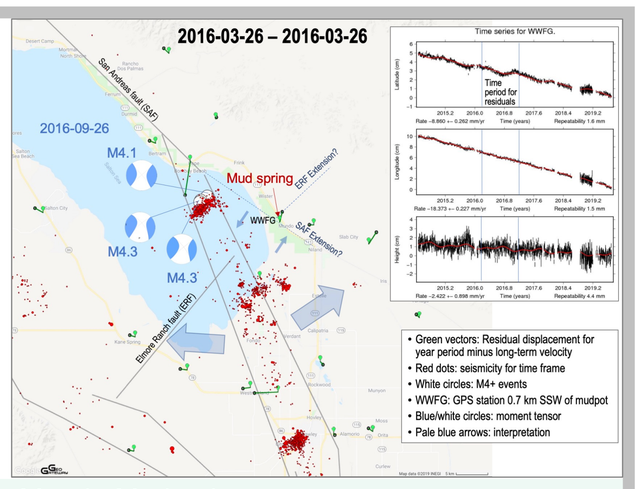
In 2016 an ambient temperature CO2 driven mud spring, east of the Salton Sea, began expanding and moving westward at a rate of about 6 m/yr threatening critical infrastructure



The objective of this project was the *characterize the local behavior of the mudpot/mudspring and identify any connection to regional tectonic controls*

FY18/19 Results:

- The Salton Trough is a transtensional environment defined by crustal thinning, high heat flow, and a network of faults that creep and slip
- We conducted sUAS measurements of the mudpot and surrounding area using to produce topographic models, and visible/thermal images
- The mudspring is ambient temperature propagating southwestward at about 5 cm/day
- UAVSAR observations decorrelate in the wet agricultural region around the mudpot and were not useful for determining surface deformation
- GPS observations show a transient transtensional shear in 2016 when the mudpot began moving when 2016 displacements are subtracted from long-term velocities



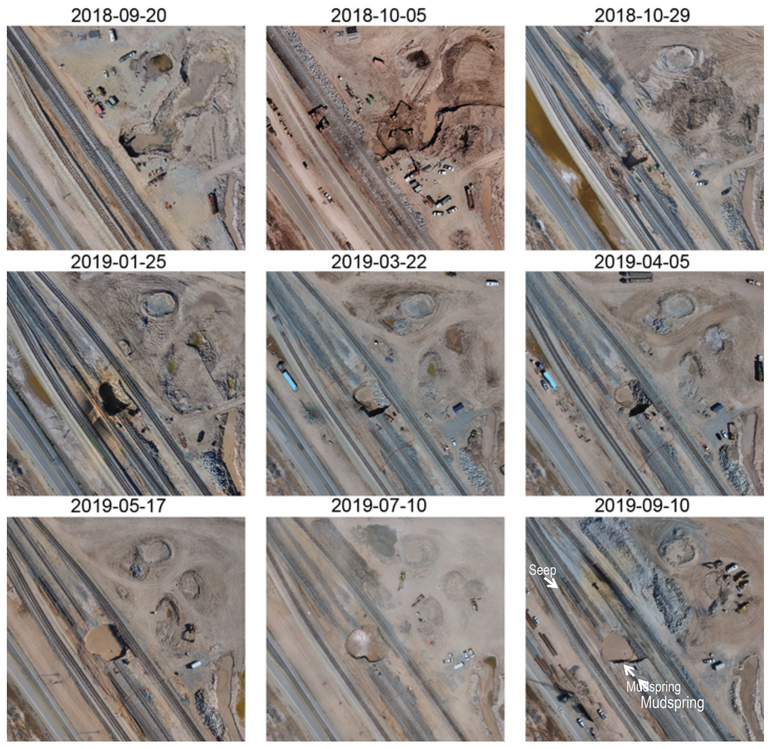
1. The 2016 Salton Trough transtensional event initiated migration of the Mundo Mudspring
2. The mudspring lies at the intersection of the extension of the Elmore Ranch, and San Andreas faults
3. Cold water runs downhill along the Elmore Ranch Fault Extension and stops at a fault barrier near Highway 111
4. The mudspring should drain or migration accelerate or drain if/when it cuts through the Highway 111 fault barrier

Benefits to NASA and JPL (or significance of results):

- These results are useful for prototyping an airborne imager to co-fly with UAVSAR or to fly in any aircraft with a nadir port
- The results demonstrate the importance of fusing multiple data types to understand solid Earth processes
- Understanding crustal deformation in southern California is key to better understanding earthquake processes and earthquake hazard
- Methods developed here are being shared with the railroad and Caltrans to assess critical infrastructure, which includes the railroad, highway 111, a gas line, and a fiber optic line

Mudspring

Mudspring can be seen as a pit that migrates southwest over time.

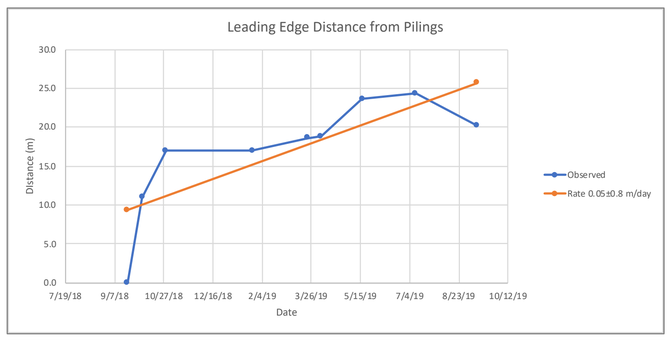


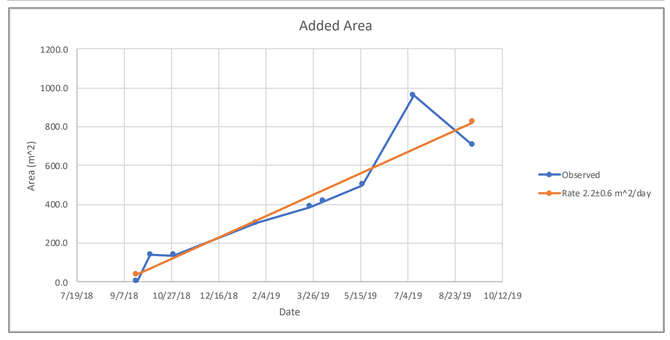
Survey Area Including Mudspring and Parking Lot

Parking lot in west side of scene has seeps that remain in the same location but change over time

Mudspring Change over Time

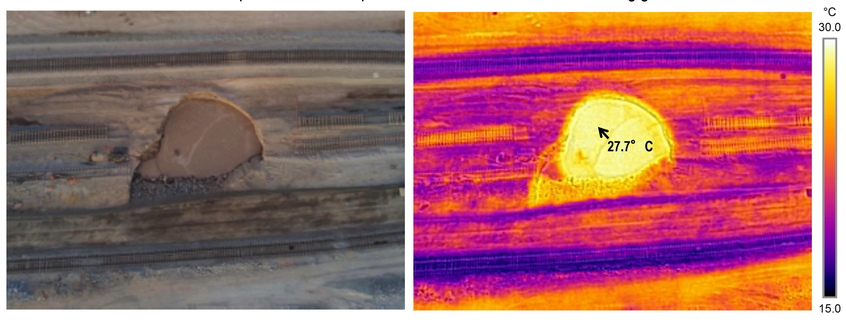
The leading edge of the mudspring is migrating southwest at a rate of about 5 cm/day. The pit grows larger by about 2.2 m^2/day, perhaps the most useful measure. The pit increases in volume over time, but is a less accurate measure because water level changes due to pumping of water out of the pit. At its current westward rate of 5-10 cm/day the pit will reach Highway 111 31 m away in 10-20 months.

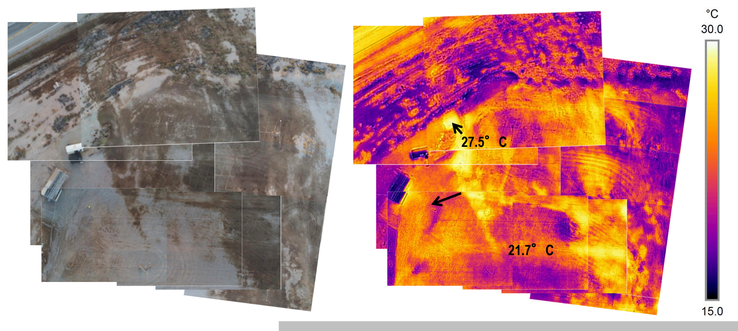


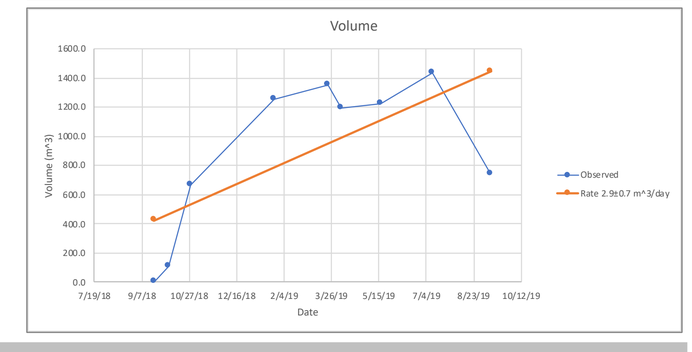


Infrared Imaging from a Small UAS

Water in the mudpit is ambient temperature but hotter than the surrounding ground



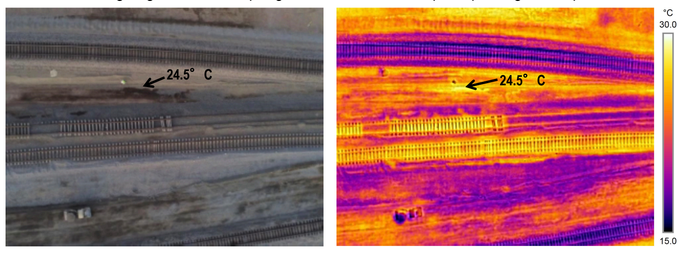




Infrared images collected 10 September 2019 using a Parrot Anafi Thermal drone

Fun fact: An engine of a passing train registered 100° C and a refrigerator car 0° C

A seep has begun forming on the side of railroad tracks 49 m northwest of the leading edge of the mudspring. It is cooler than the pit or parking lot seeps



Publications:

In preparation

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