

Eruptive Events from The Young Sun: Impact on the Atmosphere of Noachian Mars

What is the impact of the young Sun's activity on production of nitrates discovered by MLS (up to 1100 ppm) at Yellowknife Bay?

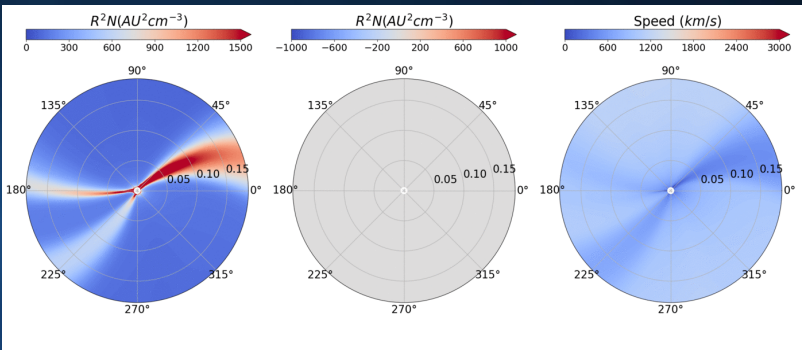
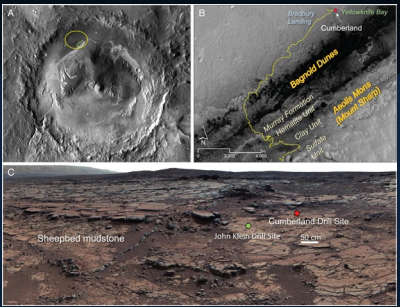


Figure 1. 3D MHD simulations of CMEs associated with a superflare from the Young Sun

- Simulated initiation and propagation of Coronal Mass Ejections from the young (0.5 Myr) Sun using 3D MHD AWSoM code
- Coupled MHD-iPATH kinetic code to calculate Solar Energetic Particle Event (SEP) spectra at Mars associated with a superflare at 2×10^{34} erg (Fig2)
- Calculated the impact of SEPs on the ionization of $N_2 - CO_2$ atmosphere of the Noachian Mars (Fig1)
- **Published a paper in Science Adv 2022; another publication in ApJ**

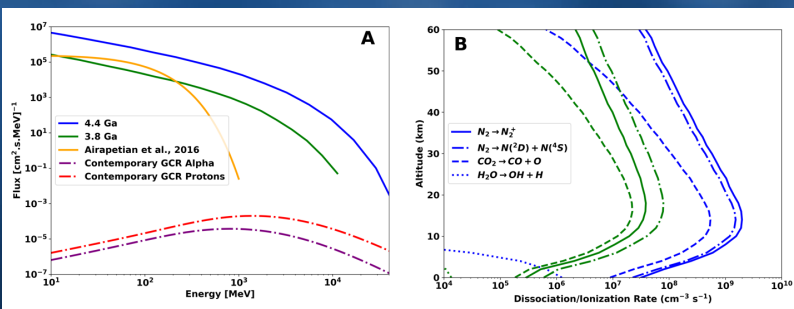


Figure 2. Left: SEP particle energy spectra associated with a 5000 km/s CME from the young Sun; Right: Profiles of ionization of Martian atmosphere

Next steps:

- Couple AEROPLANETS+ATMOS=Global ATMOS (Fig2)
- Simulate abiotic production of nitrates via nitrogen fixation due to SEPs