FAST LITHO-PANSPERMIA IN TIGHTLY-PACKED SYSTEMS AROUND M DWARFS S. Krijt[1], T. J. Bowling[1], R. J. Lyons[1], and F. J. Ciesla[1], [1]Department of the Geophysical Sciences, The University of Chicago, 5734 South Ellis Avenue, Chicago, IL 60637, USA (email: skrijt@uchicago.edu)

Introduction: When a comet or asteroid impacts a planet's surface, debris ejected above the planet's escape velocity has the potential of reaching other, nearby celestial bodies. In the inner Solar System, travel times for debris between the terrestrial planets are typically $10^{6\text{-}7}$ years [1,2], while these timescales can be much shorter in more compact systems [3]. Litho-panspermia refers to the idea that if such debris contained life-bearing material capable of surviving the initial impact, the ensuing journey through space, and the accretion onto another planet, then that target planet could be seeded with life [4].

The recently-discovered planetary system orbiting M dwarf TRAPPIST-1 is a particularly interesting environment to think about litho-panspermia because the system is very compact and potentially houses 3 Earth-size planets inside the Habitable Zone [5,6,7].

Results: We present numerical simulations using the `SyMBA` routine of the `swifter` software package [8,9,10] investigating the fate of impact ejecta in the TRAPPIST-1 system. We assume an orbital architecture and planetary masses based on [6]. Test particles are ejected from the 3 planets most likely to be in the Habitable Zone (e, f, and g) at different velocities and angles, and is followed until it is (re)accreted onto a different body or ejected from the system. Figure 1 shows the fates of test particles released at 3 different velocities [11]. While a major fraction of the ejected material re-accreted onto the planet of origin (especially for low ejection velocities), significant fractions end up on other planets. Moreover, the material transfer was found to be extremely fast: for ejection just above escape velocity, very little material was still in orbit after 10^4 years, while ~10% of ejecta reached another Habitable Zone planet within 100 years [11].

Discussion: Our simulations indicate that if there is a non-negligible flux of impactors present in planetary systems like the one around TRAPPIST-1, material transfer between planets should be relatively common and many orders of magnitude faster than in the inner Solar System, providing greater opportunities for life to find environments in which it can thrive.

With M dwarfs being the most common stars in the solar neighborhood and the planet formation process favoring tightly-packed configurations of Earth-size planets around these low-mass stars [12], such material exchange could play a significant role in the evolution of the majority of Earth-like worlds in our Galaxy.

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Acknowledgments: This material is based upon work supported by NASA under Agreement No. NNX15AD94G for the program "Earths in Other Solar Systems."

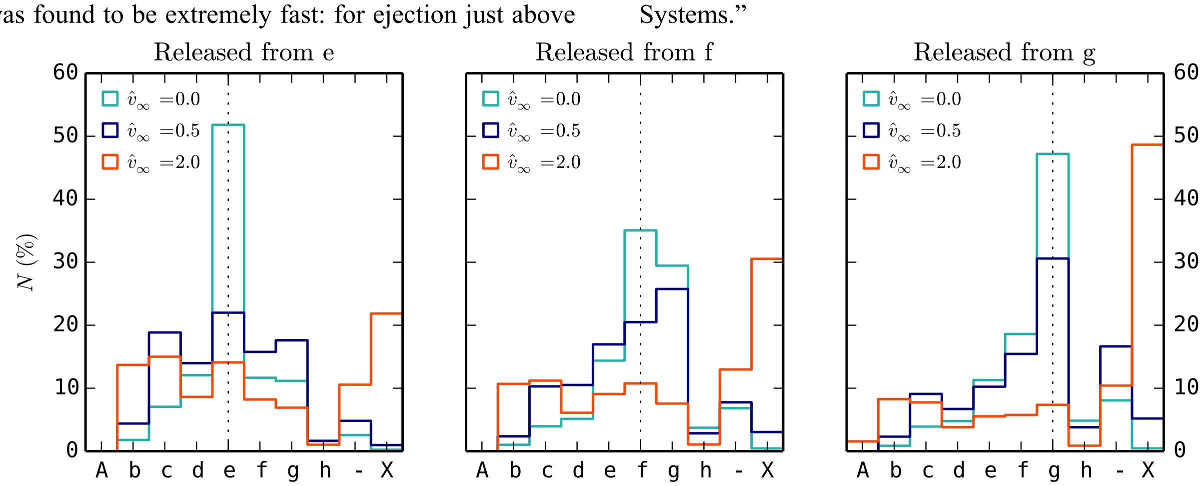

Fig. 1: Fate of ejecta after 10^4 years of being released from planets e, f, and g, at different normalized ejection velocities. Different bins correspond to: accretion onto the primary (A) or planets (b-h), ejection from the system (X), and still in orbit (-). The ejection velocity is given in units of excess velocity at infinity, normalized to the escape velocity from the planet's surface.