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Marissa Cameron^  
Department of Geological Sciences, University of Texas at El Paso, meesa86@yahoo.com

Amanda Nahm  
Department of Geological Sciences, University of Texas at El Paso, alnahm@utep.edu

Robert Pappalardo  
NASA Jet Propulsion Laboratory, robert.pappalardo@jpl.nasa.gov

Bridget Smith-Konter*  
Department of Geological Sciences, University of Texas at El Paso, brkonter@utep.edu

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Tidally Driven Coulomb Failure Along Europa’s Agenor Linea

Marissa E. Cameron\textsuperscript{1}, Amanda L. Nahm\textsuperscript{1}, Robert T. Pappalardo\textsuperscript{2}, Bridget R. Smith-Konter\textsuperscript{*1}

\textsuperscript{1}Department of Geological Sciences, University of Texas at El Paso
\textsuperscript{2}NASA Jet Propulsion Laboratory

Europa, one of Jupiter’s moons, has a fractured surface that provides opportunities to study past tectonic activity. Tidal stresses and implications for faulting can be better understood by investigating the relationship between shear and normal stresses operating on these fractures. In addition, Europa has an outer icy shell that may be decoupled from its silicate interior by a liquid water ocean; this separate rotation is thought to cause non-synchronous rotation (NSR) stresses. These additional stresses may arise as the outer shell rotates at a different rate than the interior. We investigate the relationship between the shear and normal stresses resulting from tidal formation of the icy shell at Agenor Linea, a feature on Europa. To calculate both diurnal and NSR tidal stresses at any point on Europa’s surface, we utilize a numerical code (SatStress) that calculates stresses. We use the calculated stresses to investigate possible conditions for shear failure. We find that both diurnal and NSR stresses combined are required for strike-slip faulting to occur at Agenor Linea; diurnal stresses alone do not provide stresses large enough to permit shear failure. Shear failure along Agenor Linea is possible given reasonable values of the varied parameters, although slip is very sensitive to fault depth. We find that Agenor Linea fails near its mid-section at 3 – 4 km depth, but below this shear failure is not possible.