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The Fracture Induced Electromagnetic Radiation (FEMR) induced along the Dead Sea Transform fault before the Syrian-Turkey earthquake (Mw-6.3) on 20.2.2023

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The Fracture-Induced Electromagnetic Radiation (FEMR) phenomenon has been substantially investigated as a prolific geophysical tool and provided a precursor to geohazards such as landslides, earthquakes, and rockburst hazards. Several lab-scale experiments on materials such as chalk, rocks, glass, ceramics, granite, etc., have been conducted to correlate between experimental observations and theoretical formulations of the physical parameters of FEMR generations such as crack dimensions, crack velocity, frequency of crack propagation, and finally draw an analogy with earthquake events. The FEMR working principle for Earth's fracture detection is based on generating geogenic electromagnetic radiation from the brittle rock bodies subjected to differential stress in the near-surface of the Earth's crust. When external stimuli, such as significant deviatoric stresses in thrust or shear zones due to active tectonic forces, induce stress on these rock bodies, microcracks form and propagate. The "Process zone" at the crack tip contains numerous microcracks and dipoles that emit FEMR waves in the kHz to MHz frequency range. As microcracks coalesce and lead to macro failure, the amplitude of FEMR pulses diminishes. FEMR pulses show less attenuation than seismic waves, making them a more efficient precursor to potential tectonic activities. They are an early warning sign for earthquakes a few hours or days before the event. The current study consisted of FEMR surveys along a segment of the active Dead Sea transform (DST) from Sodom to Jericho. This coincided with a 6.3 magnitude (M_w) aftershock earthquake (EQ) in the Turkey-Syrian region on February 20, 2023, where the last measurement was taken 2 hours before the EQ. Several FEMR parameters (e.g., Benioff strain release, frequency, rise time, hits or activity, and energy) along with their associated crack dimensions were analyzed after filtering the raw data and comprehending their trends leading up to the EQ. This study investigated the Benioff Strain plot and other parameters in three consecutive stages of earthquake nucleation leading to the EQ. In the first stage, there's an increase in FEMR hits and frequency, accompanied by a decrease in rise time (T') and crack dimensions. The second stage is characterized by a decline in FEMR hits and crack width while all continue to increase. Notably, the second stage accumulates the second highest energy, likely due to a high-stress drop. The third stage features a steady increase in FEMR hits and energy and an abnormal increase in crack dimensions, perhaps signifying an upcoming event of macro failure. The cyclic trend in FEMR hits suggests periods of high activity and silence, possibly related to stress changes during crack propagation. Because the measurements were taken a few hours before the

earthquake, this survey provides valuable insights into the modulation of FEMR parameters before an earthquake. The results obtained from this analysis could bridge the gap between lab-scale and large-scale studies of stress-induced rock collapses and provide a befitting precursor to such disastrous natural calamities.