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# RESEARCH SPOTLIGHT

Highlighting exciting new research from AGU journals

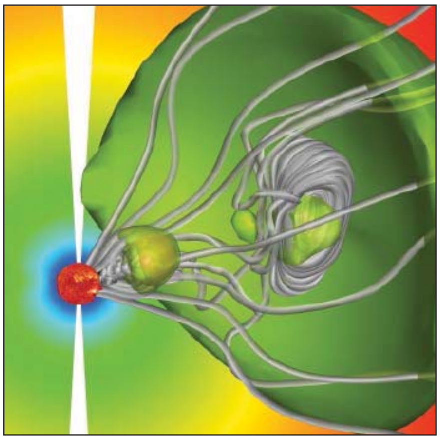


## Collisions of coronal mass ejections can be superelastic

Coronal mass ejections (CMEs), emissions of magnetized ionized gas from the Sun, can damage satellites and communication technology, so being able to predict where they are heading and how much energy they have is important in protecting this technology.

Sometimes two CMEs collide and bounce off each other like elastic balls, changing their directions and speeds. It has been suggested that in some cases the collisions can even be superelastic, which means that the total kinetic energy of the two colliding CMEs actually increases after the collision as some of the thermal or magnetic energy in the CMEs is converted to kinetic energy. However, the superelastic nature of these collisions had not been confirmed until now.

*Shen et al.* conducted three-dimensional magnetohydrodynamic simulations based on an observed collision of two CMEs in 2008. They compared a simulated non-collision case with a simulated collision case and found that the collision between CMEs does undergo a superelastic process. The kinetic energy gained in the collision was about 3–4%, which closely matches observations. The study confirms that CME collisions can be superelastic. (*Geophysical Research Letters*, doi:10.1002/grl.50336, 2013) —EB



*A simulation of two coronal mass ejections (CMEs) right before the collision. The study confirms that collision between CMEs can be superelastic. The image of the Sun comes from NASA's Solar Dynamics Observatory (SDO) spacecraft.*

## New details on transition zone below western United States

At certain depths in Earth's mantle, increased pressures cause minerals to undergo phase changes, transforming to different crystal structures. Seismic waves change speed at these discontinuities, so analyzing seismic waves at various depths gives scientists information about the structure of the mantle.

In a zone between 410 and 660 kilometers deep, the upper mantle transitions into the lower mantle. To gain more detail about the fine structure of this transition zone beneath the western United States, *Tauzin et al.* analyzed seismic waves recorded at seismic stations of the U.S. transportable array. For instance, they imaged the area where portions of the Gorda plate, subducted under northern California, flattens and causes uplift of the 410-kilometer discontinuity under northern Nevada.

They also found that the transition zone is thicker below Washington, Oregon, and Idaho. In addition, they identified minor negative discontinuities (where seismic wave velocity decreases rather than increases with depth) at around 350-, 590-, and 630-kilometer depths and show that the 350- and 590-kilometer discontinuities extend over a wide region under those states. The authors suggest that this might be related to increased water content in the transition zone there or to a significant amount of oceanic material accumulated in the area. (*Journal of Geophysical Research-Solid Earth*, doi:10.1002/jgrb.50182, 2013) —EB

## Charting the growth of the Turkish-Iranian plateau

Stretching from the Persian Gulf up through Turkey, the northwest-southeast running Zagros fold-and-thrust belt is a region of extensive crustal deformation and seismic activity. Near the Zagros Mountains the structure of the Middle Eastern region is the result of the intersection of three tectonic plates, with the Eurasian plate being squished on both sides by the Arabian and Indian plates. Convergence of the plates is driving the formation of the Turkish-Iranian plateau, a high-elevation expanse of relatively smooth terrain reaching in some places more than 2 kilometers into the sky and lying northeast of the Zagros belt.

How the Turkish-Iranian plateau formed and attained its dramatic height, however, is relatively unknown. Researchers are unsure whether the plateau grew vertically at one spot and then expanded laterally or if the entire surface area of the plateau rose concurrently. Furthermore, research suggests that the uplift related to seismic thrusts (a process largely occurring within the Zagros fold-and-thrust belt) can only account for surface elevations of up to about 1250 meters because after this point the gravitational potential energy of the crust counterbalances the horizontal compressive forces. In addition, scientists are uncertain whether the Turkish-Iranian and other similar plateaus (such as the Tibetan Plateau) grow incrementally or through periodic bursts of activity.

Mark Allen

*The landscape of the Zagros Mountains.*

Combining in-the-field measurements with existing seismicity data and global positioning system observations of surface motion, *Allen et al.* described in detail the complex interactions in and around the Zagros belt to better understand the formation of the Turkish-Iranian plateau. Based on their findings, the authors suggest that the Turkish-Iranian plateau grew incrementally, with the rate of uplift varying over time, and that both aseismic basement shortening and seismic upper crustal thickening drove the plateau's ascent. (*Tectonics,* doi:10.1002/tect.20025, 2013) —CS

—Ernie Balcerak, Staff Writer, and Colin Schultz, Writer