In this issue . . .

Testing the authenticity of nuclear warheads

As signatories to the New Strategic Arms Reduction Treaty, the United States and Russia are each committed to capping the number of deployed nuclear warheads to 1,550 by February 2018. However, the treaty lacks provisions to monitor warheads removed from delivery systems due to a dearth of methods to detect hoaxes without revealing sensitive design-related information during inspections. R. Scott Kemp et al. (pp. 8618–8623) used transmission nuclear resonance fluorescence tomography, which can map the spatial distribution of isotopes inside a warhead, to derive a measure of the warhead’s design. Warhead owners can encrypt the tomographic information using isotopic foils placed inside a detector system. The result is a measure similar to a cryptographic hash, which ensures that sensitive, design-related data cannot be detected. Using a simulated Soviet warhead from the 1989 Black Sea experiments, the authors demonstrate that rapid measurements can correctly identify canonical hoax warheads with a probability greater than 99.9%; fewer than one in 10,000 authentic warheads would be falsely flagged as a hoax. Despite outstanding technical hurdles, such as expanding the nuclear datasets and performing sensitivity studies using real warhead designs, the method might help authenticate another country’s undetonated nuclear warheads. According to the authors, the method could help solve a problem that has long bedeviled nuclear arms control. — P.N.

San Andreas tremors and low-frequency earthquakes

Similar to ocean tides, Earth’s crust slightly lifts and lowers in response to the combined gravitational pull of the sun and moon. Varying in magnitude over a 2-week period, this fortnightly tide triggers earthquakes only under certain conditions. Thus, when these earthquakes occur, they can reveal information about fault properties. Focusing on small, deep seismic events known as low-frequency earthquakes (LFEs), Nicholas van der Elst et al. (pp. 8601–8605) compared the phase of the solid Earth tide with the timing of 81,000 cataloged LFEs that occurred in California’s San Andreas fault between 2008 and 2015. The analysis revealed that the number of LFEs spikes as the fortnightly tide is waxing, as opposed to when the tide is at its peak, when the gravitational tug of the sun and the moon on Earth’s crust is at its strongest. The authors note that LFEs are most likely to occur when the fortnightly tide increases most from one step to the next. According to the authors, LFEs occur when the stress due to Earth tides exceeds the local fault strength and triggers a fault slip. — T.J.