Chenguang Sun

Rice University

Cratonic lithosphere thinning through time:
Evidence from kimberlite thermobarometry

As the keels of continents, cratons are believed to have been stable since their formation at billions of years ago. This conventional view was established from petrological, geochemical, and geophysical studies on cratonic lithosphere. Yet, evidence for the absence of cratonic roots at some Archean terrains casts doubt on the craton stability. This poses a fundamental question on the destabilization of cratons globally through time, which was often overlooked due to the lack of geological observations. To address this question, I develop a new liquid thermobarometer for kimberlite and other silica-poor, CO2-rich melts using high-temperature and high-pressure experimental data. As unique mantle-derived melts at ancient continents, kimberlite magmas are ideal tools to constrain the temporal variation of lithosphere thickness and the processes affecting the lithosphere root. Applying this new thermobarometer to global kimberlite rock records, I will show that the thickness of cratonic lithosphere has decreased globally by up to ~150 km during the past ~2 Gyr, indicating that the conventional view of stable, long-lived cratons needs to be revised. This has significant consequences on Earth’s dynamic and chemical evolution that demand a series of future studies. Taking the temporal evolution of kimberlite volcanism and subduction flux into account, I will also discuss the possible mechanism of craton destabilization through time and its implications for Earth’s carbon cycle.