Accurate and precise locations of earthquakes and explosions are essential for seismic discrimination, tectonic interpretation, earthquake hazard assessment, and tomographic imaging of Earth's internal structural heterogeneity. Traditional methods of event location, employed by global agencies that monitor global seismic activity, are rooted in algorithms developed a century ago, and do not routinely benefit from modern seismogram-cross-correlation approaches to measuring travel times, or from methods that estimate precise relative event locations. Here I describe an application of intermediate-period surface-wave cross correlation to measure inter-event travel-time delays and estimate precise relative earthquake locations in a remote area of the Mid-Atlantic Ridge. A prolific seismic swarm illuminated a 100-km-long stretch of the ridge starting in September 2022 and continuing into 2023. Precise relative locations of more than 100 earthquakes, interpreted together with their moment-tensor source characteristics, are used to register the earthquakes geographically to tectonic features revealed in detailed bathymetric maps of the area. The resulting earthquake locations are probably accurate to within a few kilometers, representing an order-of-magnitude improvement over routine catalog locations. The well-located and geographically registered earthquakes of the swarm are used to locate earlier events with high precision, demonstrating an approach that can be transported to other regions. When a group of earthquakes in a region has adequately registered, future events can be located routinely with improved accuracy.