Abstract Real-time location of earthquakes can be achieved by using direct imaging of the recorded wave field based on a Kirchhoff reconstruction method similar to that used in the migration of seismic reflection data. The standard method of event location requires the wave arrival at each sensor to be picked and associated with an event. By using direct imaging, the event is identified once in the imaged wave field. The computation is independent of the level of seismic activity and can be carried out on a typical desktop computer. The procedure has been successfully demonstrated in two and three dimensions using data from the Southern California Seismic Network (Trinet). At higher resolutions, the reconstruction method can identify finite source effects. Further work considers extending the method by implementing full elastic theory and solving for moment tensors at all locations in the mesh.