

Is Magnitude the Parameter of Choice for Induced Seismicity Regulations?

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Abstract

Over the past decade, the number, size and societal impact of induced earthquakes related to the oil and gas industry has dramatically increased in North America, the UK and China. In these countries, regulators are now routinely imposing the use of Traffic Light Systems (TLS) to try to mitigate the risks associated with induced seismicity and smooth public concerns for felt earthquakes in regions where seismicity was low or non-existent prior to the rise of oil and gas operations. To our knowledge, these regulations systematically (if not exclusively) define thresholds on magnitude, above which all operations should be paused or halted. We ask the question whether magnitude is the best parameter to use in setting up an adequate monitoring system. We argue that despite its apparent simplicity, magnitude alone is unable to encompass the physical aspects leading to surface damage; in particular, peak ground motion is critically controlled by parameters such as but not limited to site condition, source directivity, distance, and source duration. Furthermore, we note that regulators have used a variety of magnitude definitions and corresponding thresholds (with local & moment being the most used), further adding to the complexity in the adequate definition of a TLS. In this paper, we illustrate the inadequacies of using the magnitude of an individual event as the sole parameter for decision making by using ground motion data and felt reports from earthquakes recorded with the Texas Seismological Network, and we propose a definition for TLS in the context of oil and gas operations.