Comment on the paper 'A risk-mitigation approach to the management of induced seismicity' by J. J. Bommer, H. Crowley and R. Pinho

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1. Introduction

In their recent article 'A risk-mitigation approach to the management of induced seismicity' Bommer et al. (2015) present an engineering-focussed approach to the mitigation of risk from induced seismicity. This article is a welcome new viewpoint on this topic, where previous studies often only considered mitigation strategies that act on the hazard component of the problem. Bommer et al. (2015) clearly demonstrate that other ways of reducing risk (by acting on the exposure or vulnerability) are possible rather than simply trying to keep the potential earthquake shaking below a threshold above which the local population and buildings may be affected.

2. Pre-operation building surveys

One aspect that is highlighted by Bommer et al. (2015) is the assessment of the building stock in the vicinity of the potential source of seismicity. Because the possible effect of induced seismicity on structures would often be limited to slightly damage (e.g. superficial cracks) then it is vitally important to establish a detailed view of the state of the local buildings *before* the occurrence of induced earthquakes. It is necessary to establish a base line so that subsequent claims can be tied to ground shaking rather than other causes not related to the project. The following thought experiment shows the difficult in undertaking such screening.

Assume that induced seismicity is concentrated at a point. Next assume that shaking of sufficient intensity to crack buildings could occur within an epicentral radius of 3km from this point. This means that an area of $\pi.3^2$=28km^2=2 800 hectares could be affected by the project's operations. Assuming a residential density of 10 dwellings per hectare, which roughly corresponds to rural density in the UK (CABE, 2005), means that 28 000 dwellings could be affected by the operations.

To establish a snapshot of the state of these dwellings before operations start would require an onsite survey because databases such as Google Street View do not provide sufficiently detailed photographs or views of the internal state of the buildings, which would be important for any future damage claims. If it is assumed that each building would take 15 person-minutes to survey (allowing travel between buildings and the identification of any pre-existing cracks), the time taken to survey the 28 000 dwellings would be 28 000 × 15=420 000 minutes=7 000 person-hours, which corresponds to about 19 person-years. If the project was located in a remote area with lower residential densities or if the area that could be affected by the shaking was smaller the survey could be achieved more quickly. Nevertheless given the large number of buildings that would likely need visiting (probably many thousands) such surveys are likely to be too long and expensive for a project that could induce seismicity to finance. In addition, there are likely to be privacy and legal issues concerning the collection and storage of photographs of individual houses. Finally, such a database would need to be regularly updated because of the possibility of cracks from other reasons (e.g. abnormally dry/wet weather and road traffic). Consequently, it would probably be more cost-effective for the owner of the project to take out insurance to cover any damage to property in the area rather than to undertake a detailed pre-operation survey.

3. Crowdsourcing

If insurance cover was not considered to be desirable by the operator, regulator or local population, a voluntary procedure could potentially be devised to allow property owners to file details and photographs of their dwellings before the project starts. One possibility would be an easy-to-use web application where citizens, once properly informed and trained, are encouraged to upload a set of images showing the pre-operation “crack status” of their house. These photographs could be taken by smart phones and hence geo-referenced for subsequent independent validation. If an owner had uploaded pre-operation photographs to such a system then subsequent insurance claims could be facilitated. This approach, however, would rely on owners providing images that do not conceal, either intentionally or accidentally, pre-existing cracks, which would require good lighting and photographs from sufficiently close.

4. Conclusion

With the development of new technologies that exploit the subsurface (e.g. energy sources, such as geothermal power production, and carbon capture and storage) it is likely that induced seismicity will continue to occur and may affect more areas. Mitigation of the risk posed by such projects should be considered by the project operators, which will require innovative solutions that act on the hazard, vulnerability and exposure components. Bommer et al. (2015) provide a useful framework for thinking about potential solutions. These solutions could be coupled with crowdsourcing technologies that allow more detailed risk and damage assessments than would be feasible by the project operators themselves. This could lead to significant benefits for both the operators, insurers and the local population.

References

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