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# Insights into fault behaviour and seismic hazard from studying active and inactive faults over a range of timescales

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Tectonics and active faults are studied using a broad range of techniques and observations, and each of these datasets have both strengths and limitations. Ideally, a multidisciplinary approach should be used when studying active faults, to mitigate against gaps in data and knowledge, and to span the spatial scales of deformation. Furthermore different approaches can provide insights into how faults and fault networks behave over a wide range of timescales, from annual behaviour (e.g. geodesy, seismology) to millennia (e.g. paleoseismology) and millions of years (e.g. seismic reflection). By using a range of techniques to study fault behaviour over a range of timescales, we gain insights into how faults behave and interact, which ultimately can improve our understanding of the resultant seismic hazard.

For seismic hazard studies, it is important to quantify fault geometry, dimensions and connectivity as these factors influence the magnitude and propagation of earthquakes. However these are typically difficult to constrain from onshore continental faults where sub-surface information is often limited. Another important aspect to consider for seismic hazard studies is the slip rate of faults, but an aspect that is rarely considered is how slip rates vary spatially and temporally. Using seismic reflection datasets of inactive normal faults, we can study how slip rates vary over far longer timescales than can be considered from field studies alone. While it is challenging to study onshore faults using the same approach, what our findings indicate is that slip rates can vary by more than an order of magnitude over the lifetime of a single fault. Additionally, faults are almost never a single isolated structure, and instead form fault networks, with variable spacing, orientation and lengths. Understanding how a fault network behaves and interacts over time is also important to gain insights into seismic hazard.

Ultimately to gain a comprehensive understanding of fault behaviour in time and space, a range of complementary studies, including observations and modelling, are needed to span the broad range spatial and temporal scales that need to be considered when assessing active faults.