

Fault wedges and the exhumation of deformed rocks in crustal strike slip faults

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There is mounting evidence that fault rocks from the Nojima Fault (Awaji Island, Japan) have been deformed at relatively high pressure and temperature (300 MPa and 280 C). However, neither the exposed Cretaceous granitic hangingwall of the fault nor the exposed Tertiary and Quaternary sedimentary footwall have experienced burial exceeding 3 km. Hence the reasons why such high-pressure fault rocks may be observed near the surface remain unknown.

Here we present a geo-electrical study of the Nojima fault to investigate its structure, twelve years after the Kobe earthquake (1995). Six high-resolution profiles of electric resistivity tomography (ERT) were performed across the Nojima fault between the Hirabayashi drill site and the Nojima Fault Museum. Together with published outcrop descriptions and seismic reflection data, our profiles show that the main strike-slip fault is bordered by parallel and more shallow-dipping reverse faults at the meter to kilometre scales, defining 'wedges' of fault rocks. The secondary faults having a larger vertical offset than the main fault, those wedges pop up on one or two sides of the fault after each rupture. We suggest that the cumulated upward displacement of wedges over multiple ruptures might be significant. If so, repeated wedging at all scales over the long term (Cretaceous to present) lifetime of the Nojima fault might play a role in the exhumation of the fault rocks. However, it is unlikely that this mechanism alone may cause a 10 km uplift, and other co-occurring processes have to be sought for.