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The Palu-Koro and Matano faults, Sulawesi, Indonesia: Evolution of an active strike-slip fault system

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The Palu-Koro and Matano faults of Sulawesi, Indonesia, are important active strike-slip faults close to the triple junction between the Eurasian, Indo-Australian, and Pacific/Philippine Sea plates. The Palu-Koro fault (PKF) has a slip rate between about 32-45 mm/yr and left-lateral displacement of the order of 200 km. The shorter Matano fault (MF) has been considered to be a south-easterly continuation of the PKF. Palaeomagnetic evidence, plate tectonic reconstructions and the presence of exhumed Pliocene granites along the PKF all indicate that the faults were initiated no earlier than about 5 Ma. Stream offsets, deformed Quaternary fans, GPS motions and significant historical earthquakes show that the PKF, and probably also the MF, remain active to the present day.

The NNW-trending PKF is composed of a single major strand that bends at least twice along its length, once at its midpoint – associated with a large pull-apart basin, and once near its southern termination. The NW-trending MF is a more complex structure composed of several strands with numerous bends and splays. The relative size of displacement across the PKF and MF, inferred from pull-apart basins along their length, indicates that they die out towards the south and west respectively. While this means they cannot be a continuous strike-slip structure as previously envisioned, there may be a soft linkage between them. The PKF appears to be propagating southwards, and the MF may be propagating westwards towards a future mutual intersection. In central Sulawesi, significant extension within the obtuse north-eastern block mostly bounded by the two faults is commonly associated with smaller sinistral strike-slip faults sub-parallel to the PKF and MF.

The PKF-MF system may have originated as two discrete fault zones that are now in the process of coalescing. The southern bend of the PKF represents the beginning of its attempt to link to the MF in response to the MF's westward propagation. Subduction hinge roll-back in the Celebes Sea north of Sulawesi is driving slip along the PKF, and causing the extension east of the fault. The MF partly accommodates this extension. If the two faults form a 700 km-long, through-going structure in the future, they may allow the north-eastern block to rotate without internal deformation, and transfer the central Sulawesi extension elsewhere.