Relationship between fault structures detected from gravity anomalies and the aftershock distribution of the 2016 Kumamoto earthquake

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In this study, we analyze gravity anomalies in/around the focal region of the 2016 Kumamoto earthquake, evaluate subsurface features of the continuity, segmentation and faulting type of the active fault zones and discuss relationships between those features and the aftershock distribution.
The gravity data published by GSI [2006], Yamamoto *et al.* [2011], Geological Survey of Japan (AIST) [2013], Gravity Research Group in Southwest Japan [2001], and Kanazawa University data are compiled in this study. We apply terrain corrections with 10 m DEM and a low-pass filter, then remove a linear trend to obtain Bouguer anomalies. We calculate the first horizontal derivative (HD), the first vertical derivative (VD) and TDX (Cooper and Cowan, 2006) to detect subsurface structural boundary and dip angle β(Beki, 2013) to infer a faulting type of active fault zones.
The obtained HD, VD and TDX indicate the existence of the continuous subsurface structural boundary along the Futagawa fault zone. This boundary extends from the Uto peninsula to the Beppu bay except Mt. ASo area. The distribution of dip angle βalong the Futagawa fault zone implies a normal faulting, which corresponds to the faulting of this fault zone estimated geologically and geomorphologically. Aftershocks are distributed along this structural boundary from the confluence of the Futagawa and the Hinagu fault zones to the east end of the Aso volcano.
The Bouguer anomalies around the southern part of the Hinagu segment of the Hinagu fault zone indicate a right lateral faulting. The VD and TDX show a structural boundary along the segment but it is not so clear. No clear structural boundaries are observed along the Takano-Shirahata segment, although the most of aftershocks occurred around this segment. TDX implies the existence of a structural boundary with a NW-SE trend around the boundary between the Hinagu and Takano-Shirahata segments. The invariant quantity I (Perdersen and Rasmussen, 1990) shows that this structure boundary has a 3D-like structure rather than a 2D-like. Geological map indicates that this structure boundary corresponds to a boundary between metamorphic rock and sedimentary rock. The active area of the aftershocks does not extend to the south beyond this structure boundary, implying that the spatial extent of the source fault is controlled by this boundary
Around the Beppu-Haneyama fault zone, circular density structures related to active volcanoes are so dominant that we cannot recognize any linear structural boundaries, which correspond to aftershock distribution.

Keywords: Gravity Anomaly, Aftershock distribution, Subsurface structural boundary

