Gravity anomaly and fault mapping of the Ishikari Plain and its vicinity, Hokkaido, Japan

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The Ishikari Plain is characterized by the largest alluvial lowland (the Ishikari Lowland) in Hokkaido, Japan. In the eastern margin of this plain lies the Ishikari Teichi Touen Fault Zone (ITTFZ) which borders on the Miocene hill belts (Iwamizawa, Kurisawa and Umaoi hills). Past gravity studies in the Ishikari Lowland showed that low anomalies corresponding to Quaternary sediments are dominant over the plain, whereas detailed gravity structure particularly across the ITTFZ in the eastern margin of the plain has not been reported so far.

This study examines gravity structures of the Ishikari Lowland by focusing Bouguer gradient and relief-shaded Bouguer gravity, specifically to relocate the faults (the ITTFZ), and to present a gravity-based active fault mapping for correct determination of fault segmentation. Gravity analyses are based on dense gravity data measured by various institutes. Bouguer anomaly relief is produced by illuminating the artificial light from eight directions to effectively display the detailed gravity features varying laterally along the azimuth direction. The active fault distribution in the region is mapped through the relief-shaded Bouguer anomaly.

A striking linearity of the relief-shaded Bouguer gravity along the ITTFZ is found on most of the relief maps, particularly on the maps for the azimuth of the due east and west direction. This lineament shows a good agreement with both distributions of the old (Research Group for Active Faults of Japan, 1991) and new (Nakata and Imaizumi, 2002) active faults in the northern and southern parts of the ITTFZ. In the central segment of the ITTFZ, however, the lineament in the relief-shaded Bouguer map does not bear a good correlation with the known fault distributions. In contrast, gravity anomalies around the Nopporo Hill, where the Nopporo Hill Fault Zone is newly identified as an active fault system in the newly-compiled fault mapping, are small in amplitude and are associated with no abrupt gravity changes compared to its topography and surrounding fault distributions, implying that no sharp density contrast is appreciable at depths. It is also shown that the ITTFZ as a whole consists of two parallel fault strands, both of which are running approximately in the same trend and stepping each other by 1-2 km, along the western margin of the Miocene hill belts. These two belts coincide approximately with the new active fault distributions at least north of Kurisawa. In addition, the gravity relief for the azimuth of the due north (or south) direction exhibits a remarkable lineament, extending southward from near Bibai, whose southward continuation can be traced toward southeast until 20-25 km south of Atsuma along the westernmost boundaries of pre-Neogene volcanics. This implies that the geometry of the southern end of the known fault system (the ITTFZ) provides continuity along the relief-shaded Bouguer lineament roughly to the south-east.