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広帯域地震計観測と重力測定による東南極大陸中央部の地殻構造
Crustal structure of the central part of East Antarctica from broadband seismic deployments and gravity surveys

金尾 政紀 [1*], 渡邉 篤志 [2]
Masaki Kanao[1*], Atsushi Watanabe[2]

[1] 国立極地研究所, [2] 東京大学地震研究所
[1]NIPR, [2]ERI, University of Tokyo

The Antarctica's GAmburtsev Province / GAmburtsev Mountain SEISmic experiment (AGAP / GAMSEIS) was an internationally coordinated broadband seismic deployment in the middle part of East Antarctic continent during the International Polar Year (IPY 2007-2008). More than 50 broadband seismographs were deployed over huge highland on the ice sheet from the crest of the Gambursev Subglacial Mountains (GSM; including Chinese station Dome-A (79.6S, 77.4E)) to the region around Japanese station of Dome-F (77.4S, 39.6E). The broadband seismic studies from the recorded teleseismic events provide new information of fine crustal structure and constrain on the origin of GSM, and more broadly on the structure and evolution of the East Antarctic craton and the subglacial environment. The GSM has the most enigmatic tectonic features as one of the Earth frontiers. Buried beneath the thick ice sheet, the mountains are characterized by peak elevations reaching 3000 m above sea level. Until recently, only limited constraints were available on the crustal structure of the GSM and surrounding region but new data from GAMSEIS allows more detailed investigation. The gravity measurements with land-type gravity meters were conducted by the Japanese Antarctic Research Expedition (1992; JARE-33, 1997; JARE-38, and 1998; JARE-39) over the inland traverse routes from Syowa Station (69.0S, 39.6E) to Dome-F. Free-air and Bouguer anomalies based on gravity disturbance along the routes were obtained by use of both surface elevation and bedrock elevation from radio-echo sounding. A density model of crustal structure between Syowa and inland plateau was derived based on the P-wave velocity model from active source refraction surveys and of the P-wave receiver function inversions. A crustal structure of the southern part of the inland plateau was derived from only gravity data. The Bouguer gravity anomalies were calculated by assuming the layered density model of the crustal structure to fit the observed Bouguer anomalies. Decrease in Bouguer anomalies about -200 mgal from Syowa toward Dome-F indicated crustal thickness about 45km beneath the Dome region. Analyses on S-wave receiver functions and Rayleigh wave phase velocities for GAMSEIS data provided estimates on crustal thickness beneath the GSM and surrounding region. The cratonic crust surrounding the GSM was 40-45 km thickness, which agrees with the crustal thickness from gravity surveys by JAREs and was consistent with average Pre-Cambrian crustal thickness found globally. Beneath the GSM, in contrast, the crust thickness was determined almost 55-58 km and provides isostatic support for the high mountain elevations. It is considered that the thicker crust beneath the GSM may reflect the old continental feature associated with Proterozoic and/or Paleozoic orogenic events in East Antarctica. Accordingly, the whole crustal model from the Luzow-Holm Bay (around Syowa) to Dome-F and GSM were obtained for the first time by combining the results of both broadband seismic studies by GAMSEIS and gravity surveys by JAREs. The cross section over 3,000 km length in the middle part of Antarctic continent was achieved to provide predominant information on tectonic evolution of Gondwana super-continent in Earth history.

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