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PREFACE

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Special issue "The 2018 Hokkaido Eastern Iburi Earthquake and Hidaka arc–arc collision system"

Hiroaki Takahashi[1*], Nobuo Takai[2], Masahiro Chigira[3], Guojie Meng[4], Saeko Kita[5] and Takuji Yamada[6]

The 2018 Hokkaido Iburi Eastern Earthquake on 9 September 2018 was an inland moderate-sized Mw6.6 earthquake. The maximum intensity of VII, which is the highest in JMA intensity scale, was observed in the vicinity of the epicenter. This earthquake resulted in over 40 deaths, most of which were caused by enormous seismically induced landslides. Strong shaking also destroyed electric power facilities, causing a long-term electrical power outage throughout the Hokkaido region. This special issue focuses on describing this unique earthquake and discussing the characteristics of the seismic source process, strong ground motions, aftershock activity, tectonic background, and other related phenomena.

The source process and fault model of the earthquake have been reported in the following papers. Kobayashi et al. (2019a) suggested the steeply dipping rectangular fault at depths of 15–30 km using GNSS and InSAR geodetic data. Kobayashi et al. (2019b), Asano and Iwata (2019), and Kubo et al. (2020) discussed the rupture process in detail using strong motion data and suggested the existence of major slip at depths of 20–30 km, approximately 10 km shallower than the hypocenter. Additionally, Asano and Iwata (2019) simulated the seismic wavefield using a 3-D velocity model to reflect the complex subsurface structure of the focal region.

Katsumata et al. (2019) indicated that the rupture initiated in the deepest part of the aftershock region using local seismic network data with a 3-D velocity structure. They also suggested that the aftershock area consisted of three segments, which reflects a complex rupture process. The aftershock distribution and the estimated fault model were not consistent with the configuration of a nearby major active fault (the Ishikari–Teichi–Toen fault). Ohtani and Imanishi (2019) and Kobayashi (2019a, b) assessed the possible build-up of stress on this adjoining major active fault owing to co- and post-seismic crustal deformation, and the statistical characteristics of the seismic activity before and after the mainshock were investigated by Kumazawa et al. (2019) using the ETAS model.

The strong ground motions due to this event were accurately recorded by the dense nationwide seismographic network. Dhakal et al. (2019) found large PGAs and PGVs at a medium distance relative to the standard distance attenuation model. Nakano and Kawase (2019) suggested that the observed stress drop corresponded to the upper limit of a crustal earthquake. Dhakal et al. (2019) and Nakano and Kawase (2019) also reported nonlinear site amplification at seismic stations near the epicenter. Takai et al. (2019) concluded that the destructive strong shaking observed in the town of Mukawa resulted from the local and shallow underground structure based on subsurface structure surveys. The seismic source properties and amplification characteristics described herein provide insights that can lead to the better evaluation of strong ground motions.

The regional subsurface structure within the Hidaka collision system was investigated using seismic and magnetotelluric data. Iwasaki et al. (2019) illustrated that the Hidaka collision zone consists of a complex

*Correspondence: hiroaki@sci.hokudai.ac.jp
[1] Institute of Seismology and Volcanology, Faculty of Science, Hokkaido University, Sapporo, Japan
Full list of author information is available at the end of the article

crustal and upper mantle structure using controlled source seismic data and suggested that the mainshock and a number of aftershocks occurred in the upper mantle. Kita (2019) indicated that the relocated aftershocks determined by a regional seismic network were situated in an anomalously thick crust and were distributed near the boundaries of velocity and Qp attenuation structures. Nakamura and Shiina (2019) also suggested that a Qs boundary corresponded to the aftershock alignment. Ichihara et al. (2019) presented the heterogeneous electrical resistivity structure of the Hidaka collision zone and suggested a possible conductive zone in the aftershock region. Ikeda and Takagi (2019) observed a coseismic velocity reduction as well as possible crack formation in the focal region. Iwasaki et al. (2019) and Kita (2019) suggested that low heat flow was the cause of the anomalously deep rupture.

Ohzono et al. (2019) revealed a relatively high strain rate in the focal region using GNSS data and suggested that the presence of weak crustal material in the fold–thrust zone leads to strain accumulation. Ito et al. (2019) illustrated the possible convergence of tectonic blocks in northern Hokkaido from regional GNSS data, where the northern continuation of the focal region is located. These geodetic data suggest the regional and constant build-up of stress in central Hokkaido.

The topographic characteristics of seismically induced landslides were assessed by Kasai and Yamada (2019), who indicated that the slip surfaces of numerous shallow landslides formed in the remains of volcanic soil deposited 9000 year BP. The landslides resulting from this earthquake were more clustered, more numerous, and larger in scale than were expected from the magnitude of the earthquake. Fujiwara et al. (2019) reported linear surface ruptures with small displacements from InSAR images; they also extracted liquefaction areas and landslides using InSAR mapping data. Shibata et al. (2020) reported coseismic groundwater-level changes in wells.

This special issue presents the characteristics of the 2018 Hokkaido earthquake. It also presents the tectonic implications as well as clues for seismic hazard assessments. This Mw6.6 earthquake demonstrated that even a moderate-sized earthquake can halt social activity in Japan, which is equipped with advanced earthquake disaster countermeasures. The possible accumulation of stress on nearby major active faults provides important information regarding disaster preparedness. Further investigations of the complex Hidaka collision zone from geoscientific and earthquake engineering perspectives are expected in future work, which will improve existing disaster countermeasures.

Abbreviations

JMA: Japan Metrological Agency; GNSS: Global Navigation Satellite System; ETAS: Epidemic type aftershock sequences; PGA: Peak ground acceleration; PGV: Peak ground velocity; Qs: S-wave attenuation; Qp: P-wave attenuation; SAR: Synthetic aperture radar; InSAR: Interferometric SAR.

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Competing interests

The authors declare that they have no competing interests.

Author details

[1] Institute of Seismology and Volcanology, Faculty of Science, Hokkaido University, Sapporo, Japan. [2] Faculty of Engineering, Hokkaido University, Sapporo, Japan. [3] Disaster Prevention Research Institute, Kyoto University, Uji, Japan. [4] Institute of Earthquake Forecasting, China Earthquake Administration, Beijing, China. [5] Building Research Institute, Tsukuba, Japan. [6] Faculty of Science, Ibaraki University, Mito, Japan.

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