= April 2011 Fukushima earthquake =

The April 2011 Fukushima earthquake (???????? , Fukushima @-@ ken Hamad?ri jishin , lit . " Fukushima Hamad?ri earthquake ") was a potent magnitude 6 @.@ 6 Mw intraplate aftershock that occurred at 17 : 16 JST (08 : 16 UTC) on Monday , 11 April 2011 , in the Hamad?ri region of Fukushima , Japan . With a shallow focus of 13 km (8 @.@ 1 mi) , the earthquake was centred inland about 36 km (22 mi) west of Iwaki , causing widespread strong to locally severe shaking . It was one of many aftershocks to follow the 11 March T?hoku earthquake , and the strongest to have its epicentre located inland .

The earthquake occurred as a result of normal faulting to the west of Iwaki and triggered numerous landslides across adjacent mountainous areas . A few fires broke out , and 220 @,@ 000 households lost electricity . Officials issued localised tsunami alerts , though no significant waves were generated . The earthquake caused little structural damage , but killed four people and injured ten others . The strong ground movements triggered the reactivation of a nearby geological fault , prompting researchers to conduct extensive surveys in the region .

= = Geology = =

The magnitude 6 @.@ 6 Mw Fukushima Hamad?ri earthquake occurred inland on 11 April 2011 at 08 : 16 UTC at a focal depth of 13 km (8 @.@ 1 mi) , about 36 km (22 mi) west of Iwaki , Fukushima , or 161 km (100 mi) north @-@ northeast of Tokyo . To the east of the epicentre , the oceanic Pacific Plate is subducted beneath the continental Okhotsk Plate , on which much of Honshu 's T?hoku region is situated . Building stress near the resultant plate boundary has led to the development of shallow inland faults through crustal deformation and folding along the east coast of T?hoku . This intraplate earthquake occurred in the vicinity of the Idosawa Fault ? a shallow crustal fault in the Hamad?ri region near Tabito town , Iwaki city , that had previously been inactive .

Surveys near the epicentre revealed a surface rupture of about 11 km (6 @.@ 8 mi) and numerous fault scarps , with general vertical displacements of 0 @.@ 8 to 1 @.@ 5 m (2 @.@ 6 to 4 @.@ 9 ft) ; a maximum displacement of 2 @.@ 3 m (7 @.@ 5 ft) occurred at the small village of Shionohira . Localised right @-@ lateral slip of 30 cm (12 in) was observed at the subsiding west side of the rupture . The segments of the Idosawa Fault associated with this surface feature were classified as the " Shionohira Fault " in 2011 . The proximate Yunodake Fault , a normal dip @-@ slip fault northeast of the Shionohira Fault that had been dormant for 120 @,@ 000 ? 130 @,@ 000 years , also ruptured during the quake . These observations indicated that the earthquake occurred as a result of normal dip @-@ slip faulting with some strike @-@ slip component .

Although it was centred near a different fault zone , the earthquake was classified as an aftershock of the 11 March T?hoku earthquake , which occurred offshore about 235 km (146 mi) to its northeast . The magnitude 9 @.@ 0 Mw earthquake triggered widespread seismic activity , and its aftershock sequence includes well @-@ over 67 earthquakes of magnitude 6 @.@ 0 Mw or greater . Apart from the Fukushima Hamad?ri earthquake , four of the aftershocks measured magnitude 7 @.@ 0 Mw or higher . The Fukushima Hamad?ri earthquake , however , was the strongest of the aftershocks to have its epicentre located inland . Early estimates placed the strength of the earthquake at a magnitude of 7 @.@ 0 ? 7 @.@ 1 , but the United States Geological Survey (USGS) lowered the magnitude to 6 @.@ 6 . The Japan Meteorological Agency (JMA) assessed a magnitude of 7 @.@ 0 Mj and a depth of 6 @.@ 4 km (4 @.@ 0 mi) .

The Fukushima Hamad?ri earthquake was succeeded by a number of smaller tremors ; that same day , at least 11 earthquakes of magnitude 3 @.@ 5 Mj or higher were recorded near its epicentre . Of the series , the strongest registered at a magnitude of 5 @.@ 5 Mj and occurred within 3 @.@ 5 hours after the initial quake . A shallow magnitude 6 @.@ 0 Mw (6 @.@ 4 Mj) earthquake and several smaller tremors struck the region on 12 April .

= = Effects = =

The earthquake struck in the late afternoon near a moderately populated region of the Fukushima Prefecture , although most structures around the epicentre were resistant to earthquake shaking . Focussed at an unusually shallow depth , the earthquake generated significant shaking throughout many adjacent prefectures . The strongest ground motion registered at severe (MM VIII) in Ishikawa town on the Mercalli intensity scale . Strong shaking (MM VI) spread through Iwaki , Sukawaga , Kuroiso , ?tawara and Kitaibaraki , with light tremors (MM IV) felt in areas up to several hundred kilometres from the epicentre , including Tokyo and Yokohama . The earthquake cut electricity to about 220 @,@ 000 households , with most of the cuts reported in Iwaki city . Workers at the Fukushima Daiichi power plant ? distanced 70 km (43 mi) from the epicentre ? evacuated to safety , and external power to the plant was cut . The outage briefly disrupted cooling water injections into three of the reactors , but services to the plant were restored by 18 : 05 JST . Authorities at Tokyo International Airport closed all runways momentarily , while NTT DoCoMo restricted voice calls in 14 prefectures following the quake . East Japan Railway Company temporarily suspended its services to restart four of five bullet @-@ train lines ; other Shinkansen bullet trains in the region were also halted .

The earthquake sparked several fires in Iwaki , with one fire breaking out in Asakawa town . Fire engines extinguished a blaze in a liquefied natural gas tank at Daiichi Sankyo 's Onahama Plant . Most of the structural damage was due to scattered rock- and landslides along hillsides in the vicinity of Iwaki . A landslide crushed two vehicles and buried three homes in the city , trapping a number of the inhabitants . The incident resulted in two immediate deaths . Four people were critically injured and taken to hospital ; one of them was later pronounced dead . The Iwaki Ibaraki Route 14 interchange of the J?ban Expressway , which runs from Misato , Saitama , to Tomiya , Miyagi , was cut off to traffic by a large landslide of 120 m × 100 m (390 ft × 330 ft) . In Tabito town , very close to the epicentre , a 170 m × 50 m (560 ft × 160 ft) landslide resulted in the formation of a quake lake ? a natural damming of a river by mass wasting ? with a water level of 15 m (49 ft) and a storage volume of 1 @,@ 000 ? 2 @,@ 500 m3 (35 @,@ 000 ? 90 @,@ 000 cu ft) . Significant land deformation with traces of uplift was observed in and around town , affecting local roads but largely sparing its structures .

A total of seven people from other regions near the epicentre , including southern Ibaraki , Tochigi and Kanagawa prefectures , suffered minor injuries . Another person was injured during the magnitude 6 @.@ 0 (Mw) aftershock of 12 April . In a report from July 2011 , the Fire and Disaster Management Agency confirmed a death toll of four from the earthquake .

= = Response = =

The Earthquake Early Warning system was activated upon the detection of primary waves ? seismic waves that forego an earthquake 's perceivable ground motions ? giving residents 6 @.@ 8 seconds to seek cover before the main shock . At the risk of a tsunami ? which reach their destructive wave heights near shallow coastal waters ? local fishing boats along coastlines were shown heading out to sea on national news broadcasts . A warning for a localised tsunami of up to 2 @.@ 0 m (6 @.@ 6 ft) was issued by the Japan Meteorological Agency ; however , no significant waves were recorded , and the warning was cancelled soon thereafter . In response to the earthquake , the fire department dispatched search and rescue teams and emergency crews for relief efforts and damage assessments throughout the affected area . Six medical crews in pairs of two were also sent to Kanagawa , Chiba and Gunma prefectures . Former Prime Minister Naoto Kan postponed a press conference scheduled for 17 : 50 JST marking the one @-@ month anniversary of the catastrophic T?hoku earthquake and tsunami .

The Fukushima Hamad?ri earthquake occurred in a region with historically low levels of seismicity ; studies showed that the recent activity near the fault zone had been triggered by the T?hoku earthquake . Ever since the earthquake triggered their reactivation , the Shionohira and Yunodake faults have provided essential data for local geological surveys on regional land deformation , sedimentary rock distribution and landslide vulnerability . In the earthquake 's aftermath , Professor Yagi Hiroshi from the Faculty of Education , Art and Science noted that " a possibility exists for

widespread aftershocks of the same size to occur in the near future . "