浦項工大新聞

What is Going On Beneath the Earth's Surface in South Korea?

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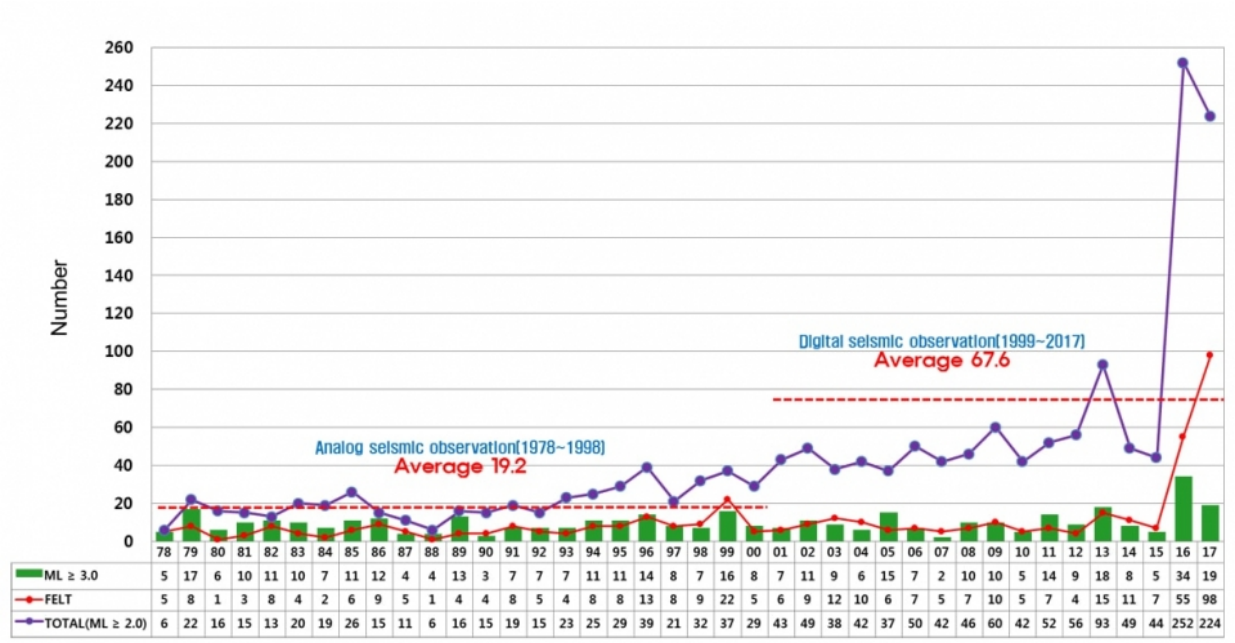

	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
ML ≥ 3.0	5	17	6	10	11	10	7	11	12	4	4	13	3	7	7	7	11	11	14	8	7	16	8	7	11	9	6	15	7	2	10	10	5	14	9	18	8	5	34	19
FELT	5	8	1	3	8	4	2	6	9	5	1	4	4	8	5	4	8	8	13	8	9	22	5	6	9	12	10	6	7	5	7	10	5	7	4	15	11	7	55	98
TOTAL(ML ≥ 2.0)	6	22	16	15	13	20	19	26	15	11	6	16	15	19	15	23	25	29	39	21	32	37	29	43	49	38	42	37	50	42	46	60	42	52	56	93	49	44	252	224

▲Earthquake trends in Korea / Korea Meteorological Administration

"Civilization exists by geological consent, subject to change without notice." This quotation, attributed to the historian Will Durant, seems appropriate after the recent experience of the M (Magnitude)5.8 and M5.4 earthquakes in Gyeongju and Pohang, South Korea, respectively.

At 7:44:32 A.M. and 8:32:54 P.M. Korea Standard Time on Sep. 12, 2016, M5.1 and M5.8 earthquakes occurred approximately one hour apart in the city of Gyeongju and were felt even in the capital city, Seoul, more than 300 km to the northwest. This M5.8 earthquake is considered the largest earthquake in terms of magnitude to have

occurred in South Korea during the modern instrumental recording period since 1978. Fourteen months later, on Nov. 15, 2017, M5.4 earthquake, the second largest event during the instrumental period, occurred in the city of Pohang. Because of this earthquake, the College Scholastic Ability Test (CSAT) was postponed for a week for the first time ever because of concerns for the safety of the students at some sites in Pohang. These recent earthquakes reflect complex subsurface processes in the earthquake-affected areas.

Why do earthquakes occur? Earthquakes happen in the Earth's crust, and the shaking of the ground is caused by a sudden movement of rock. Such movements occur along faults, which are thin zones of crushed rock separating plates of the Earth's crust. Because fault surfaces are rough, rocks that meet along a fault do not slide freely past each other but are locked by friction for long periods. Over decades to millennia, strain builds up within the rocks along the fault. At some point, the amount of strain exceeds the frictional forces that are preventing movement. The fault then ruptures. Rocks on either side of the fault slide rapidly, and accumulated strain is subsequently relieved. During this process, the energy released creates seismic waves that radiate through the crust to the Earth's surface, causing the ground to shake. This 'stick-slip' process (a long period of 'stick' is followed by a short period of 'slip') is called the earthquake cycle, and the process repeats itself over time.

The occurrence of the 2016 Gyeongju and 2017 Pohang earthquakes invoked a re-examination of the previously held consensus regarding the activities of the fault system in South Korea. The earthquake in Gyeongju occurred along the Yangsan fault system, an interrelated system of the north-northeast–south-southwest-trending Yangsan fault and its splay faults. Parts of the city suffered small to moderate damages in building structures but no fatalities were reported. However, in Pohang, there was significant damage to infrastructure, and residents were disturbed by the aftershocks of the M5.4 event (for example, the M4.6 earthquake at 5:03:03 A.M. on Feb. 11, 2018). The complex source mechanism of the 2017 Pohang earthquake reflects an intricate fault network that is not yet fully apparent.

Based on the historical records from 2 to 1989 CE, more than 500 earthquakes occurred in the region surrounding Gyeongju City, with at least 126 earthquakes occurring in close proximity to the Yangsan fault system (Lee and Jin, 1991). Based on these records, at least ten of these 126 earthquakes with a seismic intensity exceeding Modified Mercalli Intensity Scale VIII have occurred in Gyeongju, presumably related to the activity of the Yangsan fault system. A notable earthquake (possibly the event with the largest magnitude in this region over the past 2000 years; Lee and Jin, 1991) occurred in 779 CE, taking the lives of at least 100 people according to 'Samguksagi', the oldest surviving chronicle of Korean history.

The two recent earthquakes are forceful reminders that earthquakes have occurred in the past and can strike the region again at any time. These earthquakes reaffirm such knowledge based on evidence from both historical and seismological data. To mitigate impending seismic hazards in Gyeongju and Pohang, dense seismic networks have been installed to collect data for locating earthquakes and tracing fault rupture zones. The first seismic network for monitoring aftershocks was implemented immediately after the M5.1 and M5.8 earthquakes in Gyeongju. Recording began less than an hour after the M5.8 event, and, within three days, a total of 27 stations were fully operational, covering an area of ~38 × 32 km2 in Gyeongju. Similar efforts were carried out in Pohang to monitor current seismic activities. Furthermore, real-time warning systems at CSAT exam centers were installed in Gyeongju in 2016 and Pohang in 2017, not only to monitor aftershocks but also to provide an on-site earthquake drill in the event of an earthquake on the day of a CSAT. With these seismic networks, we may be one step closer to understanding subsurface fault-zone processes associated with earthquakes in South Korea.

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