Development of displacement enlargement system and an application for small strain strain seismograph

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The author has developed a borehole stress meter and strain meter (Ishii and Asai;2015) and installed it at many deep borehole stations , and also recorded stress and strain seismograms well (Ishii and Asai;2017). The dynamic range is also wide, and it has become clear that all large ground motions that will occur in the future can be recorded without being scaled out (Ishii et al.; 2019). In the case of borehole instruments, installation requires the production of instruments based on borehole drilling and cylindrical containers, which is expensive. Since there is no limit of the dimensions in the expansion mechanism for observation on the ground, the expansion of the displacement variation is considered easy. Therefore, we developed a displacement expansion system and tried to develop a small strain meter that can record strain ground motions at low cost on the ground. The expansion system was made into an arm of about 10 cm, and it was enlarged by two stages by applying the principle of leverage. The support and connection of the arm adopted a high-terinbar of the constant modulus alloy. As a result of testing the fabricated expansion system using a test device, it was found that the added displacement is enlarged by about 60 times. We tried to apply this to actual observations.
The Institute owns the observation station of the horizontal tunnel and obtains data with a 30m long quartz strain meter. In order to observe the strain between the fixed end of the 30m strain meter and the first support table (distance 1.1 m) of the first quartz glass, the displacement magnification device (about 60 times the magnification) was installed and the variation was recorded. As a result, the recording by the expansion system was almost the same record as the strain meter of 30m length. In fact it is estimated that the same results as the 30m strain meter can be obtained even in the variation of shorter intervals. Details will be reported in the presentation.

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Ishii, H. and Y. Asai , 2017, Elastic invariants observed by borehole stress and strain meters and the reliability of the instruments, Zisin2, 69.49-58.doi:10.4294/zisin.69.49 (in Japanese with English abstract).

Ishii, H. and Y. Asai, and M. Furumoto, 2019, How wide is the observation range of both stress and strain observed by stress meter developed for continuous record ? - characteristics of observation data obtained from comparisons with both wave forms of long period seismometers and GNSS data -, Zisin2, 71.139-149.doi:10.4294/zisin.2018-3 (in Japanese with English abstract).

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