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A Truly Very Broadband (VBB) Borehole Seismometer with flat Response over five Decades of Frequency

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Decades ago new opportunities in seismology were opened by the development of broadband seismic sensors with feedback. The three defining characteristics of these instruments were the bandwidth extension to longer periods, a much lower intrinsic noise and a higher dynamic range. However, the goal of further extending their bandwidth to frequencies above 100 Hz has proven elusive because these sensors are plagued by parasitic resonances leading to modes not controllable by the feedback system. Here we present a new low noise seismic borehole sensor with a truly VBB flat response over five frequency decades from 2.7 mHz (360 sec) to 270 Hz. The instrument has no mechanical resonances below 400 Hz. We achieved the bandwidth extension to high frequencies with improvements of the mechanical design, i.e. the arrangement of the pivots and the geometry of the spring. The design is realized in a borehole arrangement, where three sensors are stacked in 90-degree angles to each other. Including a single jaw hole-lock as a clamping mechanism the complete stack has a diameter of 89 mm, is 625 mm long and weighs about 24.5 kg. We show test results from three co-located complete borehole sensors with identical frequency responses.

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Promotional text

Detecting small underground nuclear explosions depends on the ability of a seismometer to record high frequencies, as well as on its sensitivity. Our new broadband borehole sensor fills this need and improves detection thresholds by spanning five decades of seismic frequencies.

Oral preference format

in-person

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