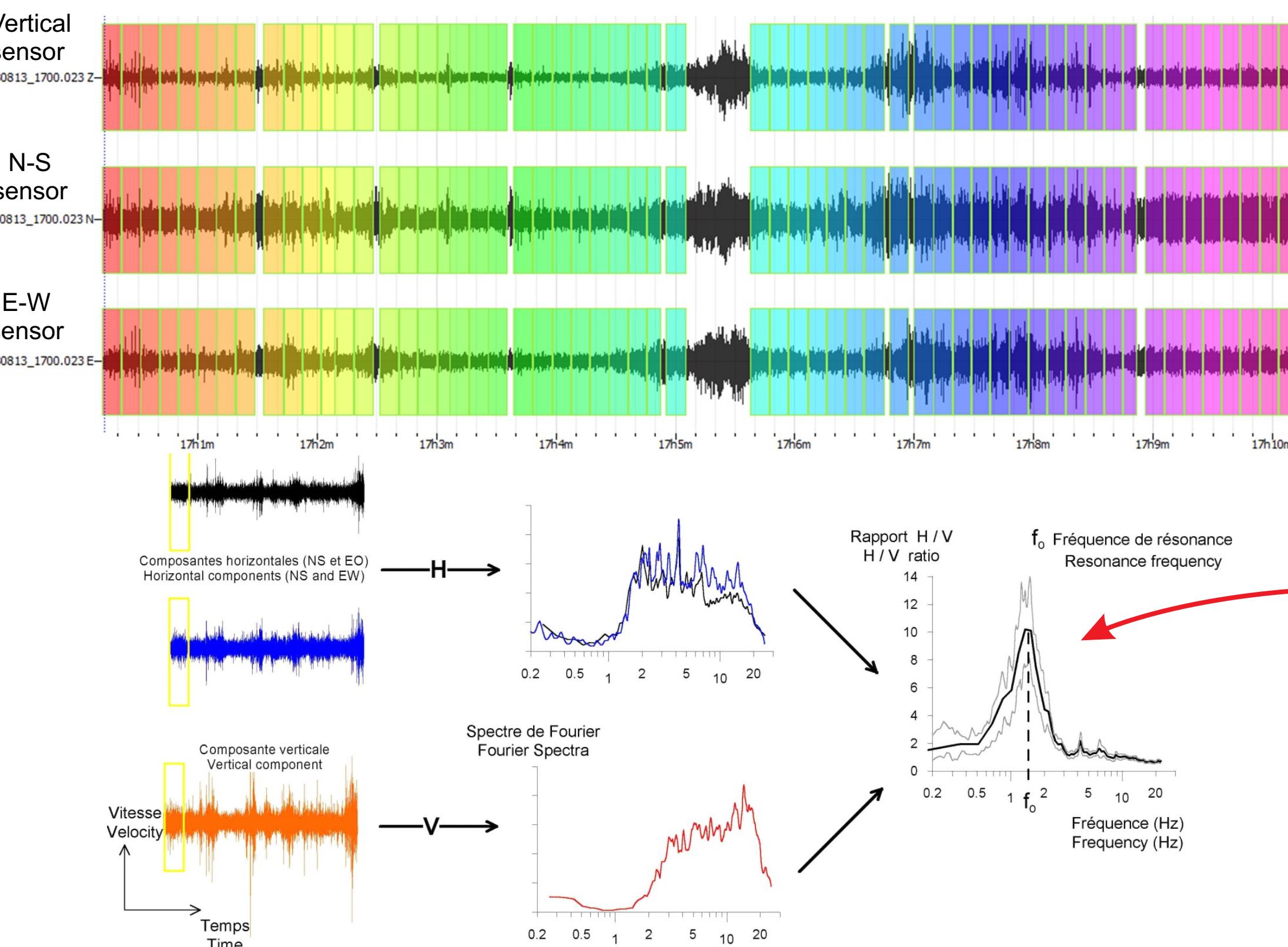


VIRTUAL BOREHOLES from ambient noise geophysics

Koen VAN NOTEN, Martin ZECKRA, Thomas LECOCQ, Raphael DE PLAEN, Julien GOVOORTS

THE TECHNIQUE: HORIZONTAL/VERTICAL SPECTRAL RATIO OF AMBIENT SEISMIC NOISE

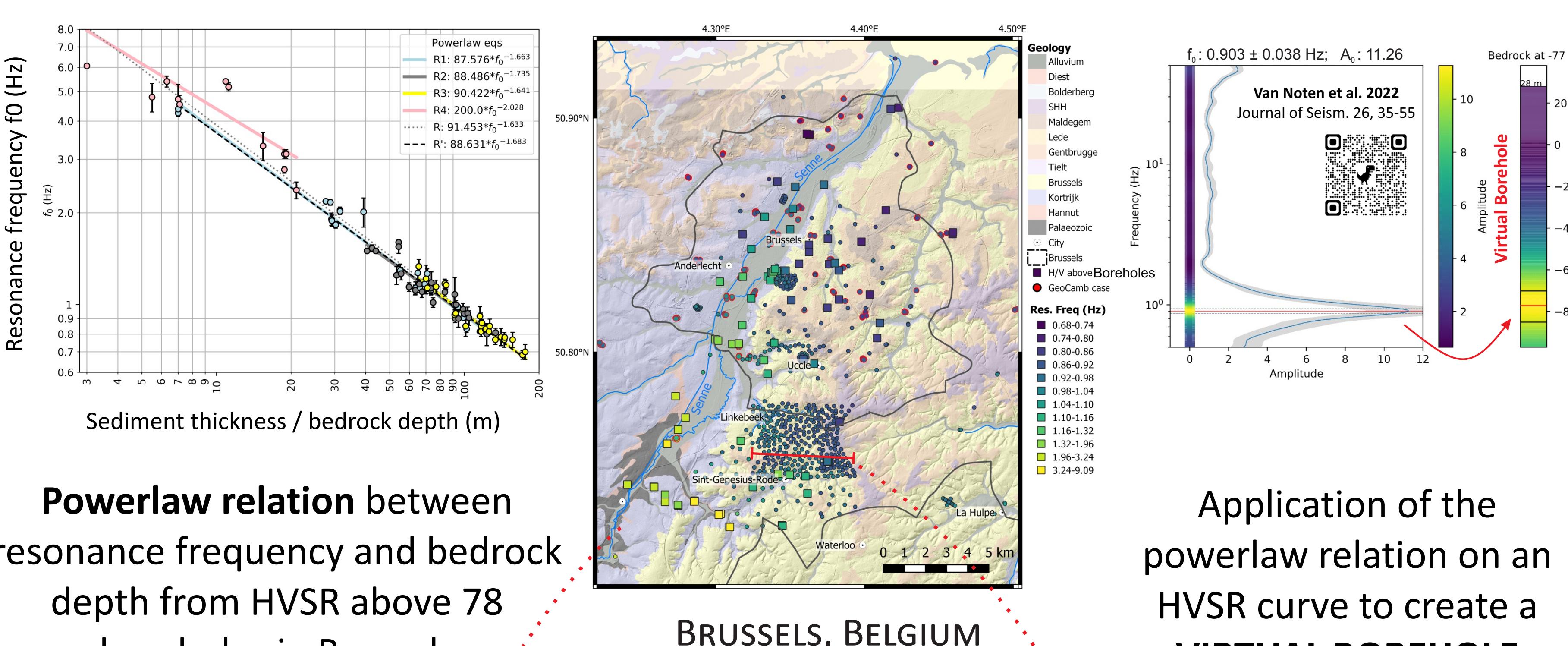


- ☒ Min. 1 h record of ambient noise
- ☒ Record divided in 60s windows
- ☒ Fourier spectrum analysis
- ☒ Dividing the Horizontal over Vertical spectra

-> Corresponding peak = Resonance frequency

Sensitive to impedance contrasts and able to detect the thickness of soft sediments over bedrock

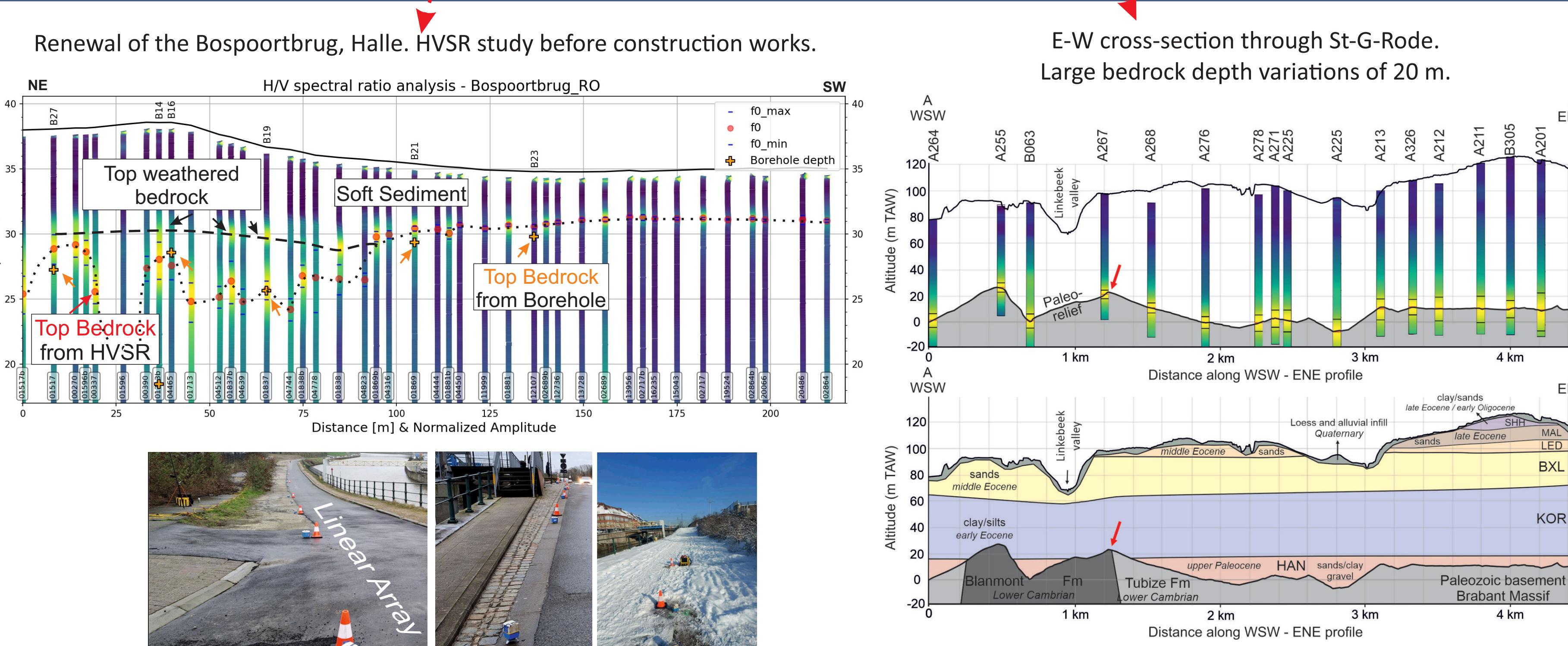
THE CALIBRATION: RELATION BETWEEN DEPTH AND RESONANCE FREQUENCY



Powerlaw relation between resonance frequency and bedrock depth from HVSR above 78 boreholes in Brussels

Application of the powerlaw relation on an HVSR curve to create a VIRTUAL BOREHOLE

VARIABILITY OF THE TOP OF THE BRABANT MASSIF



Renewal of the Bospoortbrug, Halle. HVSR study before construction works.

THE ACTORS: SMARTSOLO IGU-16HR 3C AND IGU-BD3C-5 GEOPHONES



©Koen Van Noten, Royal Observatory of Belgium
SmartSolo® IGU-16HR 3C connected to standard battery tripods during an urban seismology campaign in Brussels



SmartSolo® IGU-16HR and IGU-BD3C-5 seismic sensors used for geophysical prospection below a bridge in Halle (BE)

THE SITES: BOREHOLES AND NEAR BUILDINGS WITH GEOTHERMAL INTEREST



Borehole P2, Abattoir, Anderlecht
71 m depth, $f_0 : 1.08$ Hz



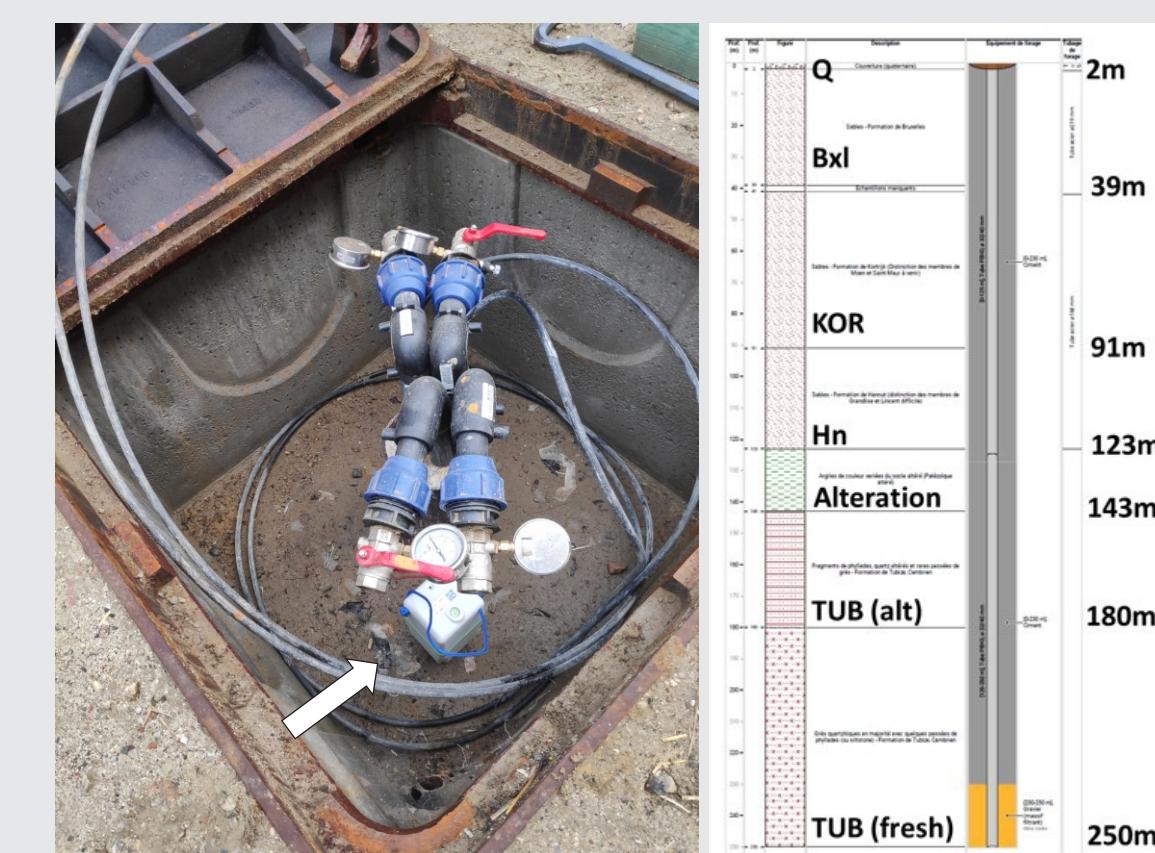
Boreholes I03 & I07, Clinic St-Pierre, Wavre
57.5 m depth, $f_0 : 1.46$ Hz



Borehole F3 & F3bis, Beaulieu, Anderlecht
99.5 m depth, $f_0 : 0.89$ Hz



Borehole B1, brewery Trois Fontaines, Lot
14 m depth, $f_0 : 4.16$ Hz

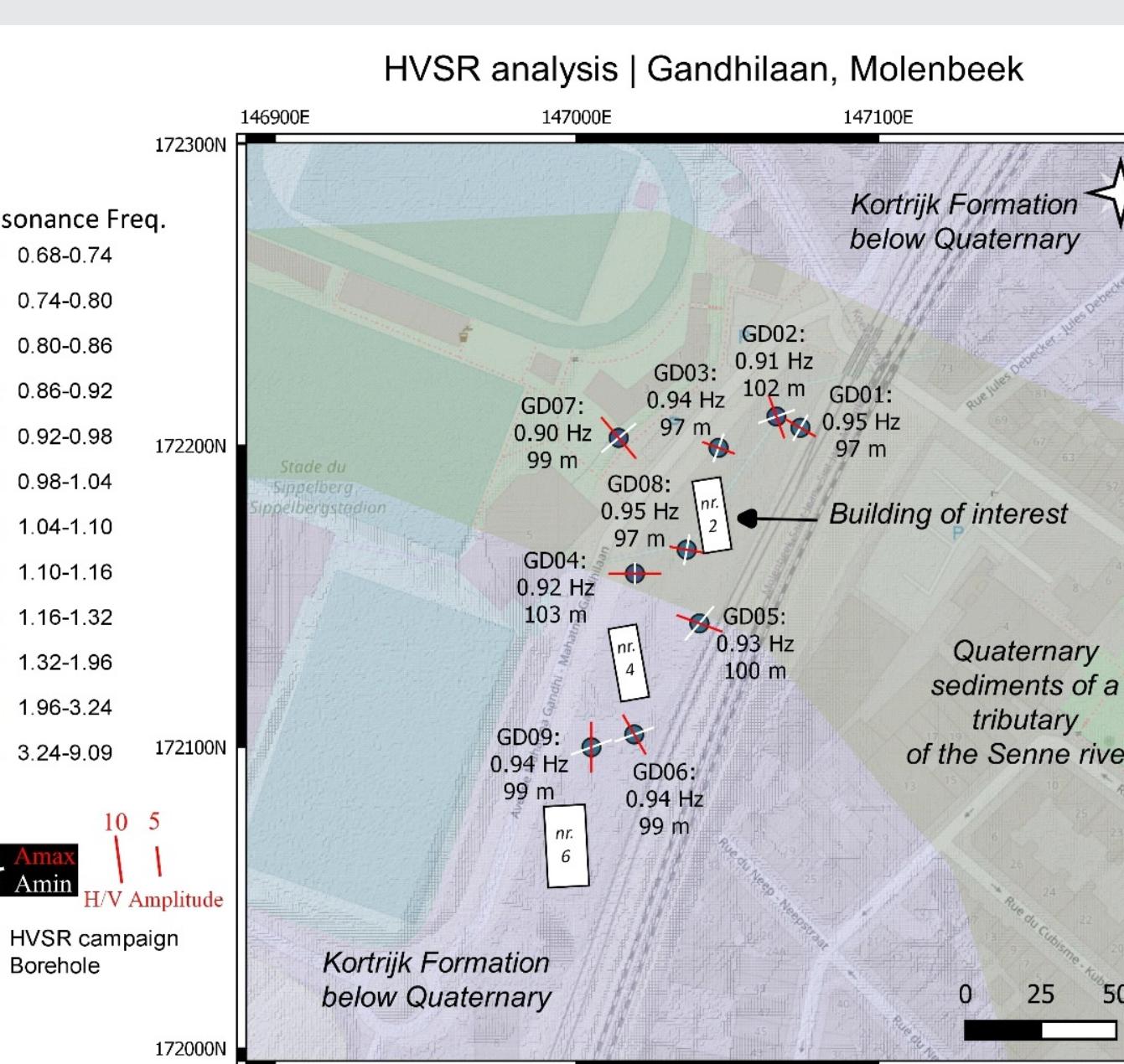


Borehole P2,
USquare, Elsene
123 m depth
 $f_0 : 0.84$ Hz

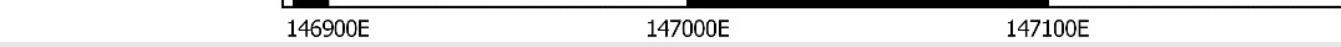


Building renovation
Borehole F1, Ghandilaan, Molenbeek
101.5 m depth, $f_0 : 0.90$ Hz, predicted depth 104 m

BUILDING LOGEMENT MOLENBEEKOIS, GANDHILAAN, MOLENBEEK



HVSR analysis | Gandhilaan, Molenbeek



Building renovation
Borehole F1, Ghandilaan, Molenbeek
101.5 m depth, $f_0 : 0.90$ Hz, predicted depth 104 m



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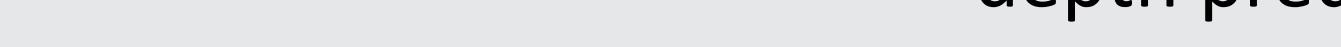
Borehole F1, Ghandilaan, Molenbeek
101.5 m depth, $f_0 : 0.90$ Hz, predicted depth 104 m



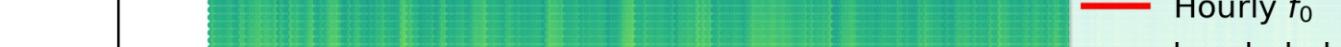
Borehole F1, Ghandilaan, Molenbeek
101.5 m depth, $f_0 : 0.90$ Hz, predicted depth 104 m



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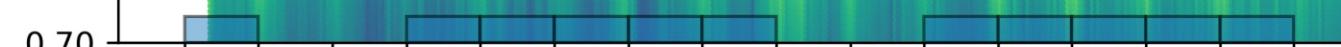
Borehole F1, Ghandilaan, Molenbeek
101.5 m depth, $f_0 : 0.90$ Hz, predicted depth 104 m



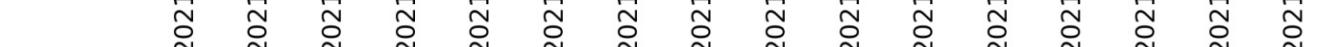
Borehole F1, Ghandilaan, Molenbeek
101.5 m depth, $f_0 : 0.90$ Hz, predicted depth 104 m



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101.5 m depth, $f_0 : 0.90$ Hz, predicted depth 104 m



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101.5 m depth, $f_0 : 0.90$ Hz, predicted depth 104 m

Borehole F1, Ghandilaan, Molenbeek
101.5 m depth, $f_0 : 0.90$ Hz, predicted depth 10