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SWISS COMPETENCE CENTER for ENERGY RESEARCH
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Deep Borehole Seismometer Demonstrator

Charles Praplan, Christian Cachelin, Joseph Moerschell
HES-SO Valais-Wallis, Rawyl 47, 1950 Sion

In cooperation with the CTI

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Hes·so VALAIS WALLIS
School of Engineering

1. What is the problem ?

Environmental sensors are currently not well suited for DGE monitoring:

- scientific sensors are too costly or not available for deep boreholes.
- fracture motion detection puts particular requirements on sensors.
- commercial equipment (e.g. for oil/gas reservoir exploration and monitoring) is not always adequate for water reservoir monitoring

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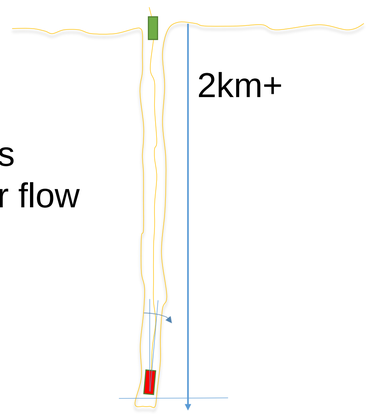
2. New deep borehole seismometer

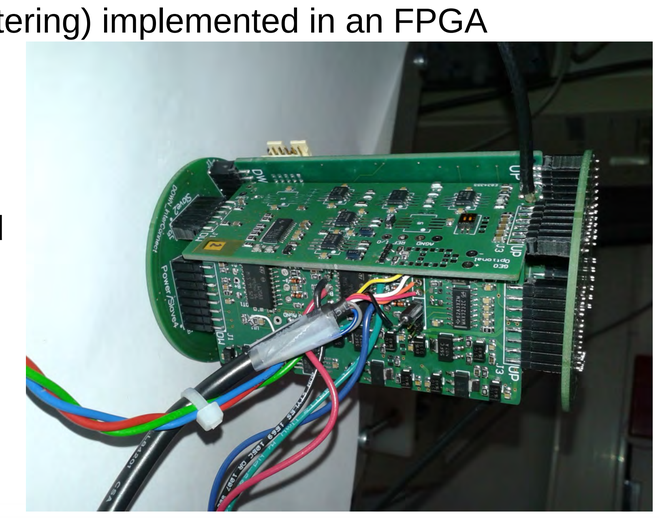


- Monitor induced seismicity close to it's origin
- Performance target: sense microseismic events related to rock fracturing and pressurized water flow
- Extreme environment: 200bar+, 150°C, highly corrosive materials
- High temperature tolerant sensor front end with acquisition electronics
- Geophone sensors in three axes
- Capability to measure inside up to 30° inclination borehole
- Mechanically stiff mounting for large bandwidth acquisition up to 400sps.
- Electronic sensitivity enhancement by active termination (negative impedance conversion)

3. Electronics compartment

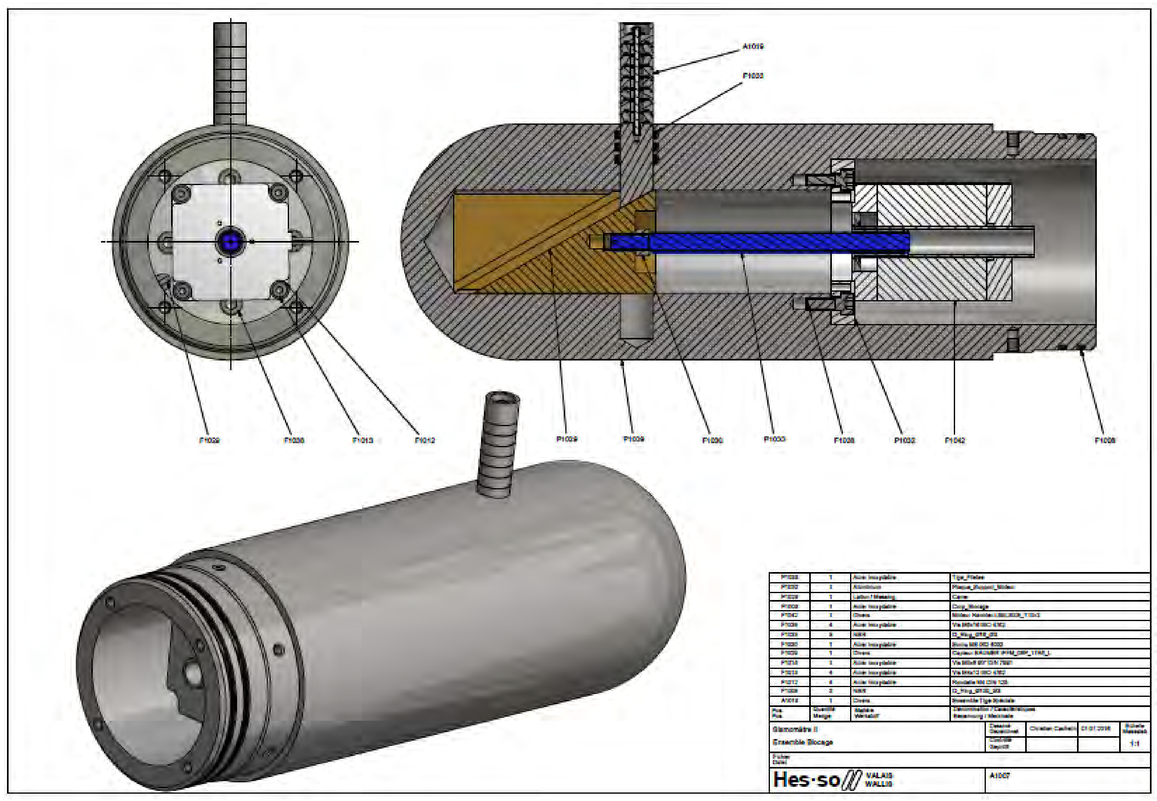
The electronics of the seismometer comprise

- Three channel active termination circuits and A/D conversion
- Preprocessing of data (filtering) implemented in an FPGA
- Serial communication interface to the cable, capable of transmitting over long distance.
- Power supply circuits and housekeeping sensors
- Two motor controllers for the blocking devices



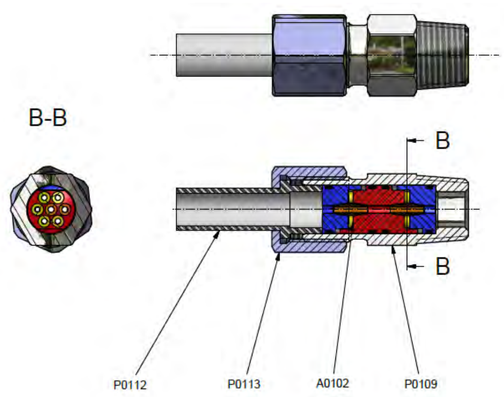
4. Seismometer blocking device

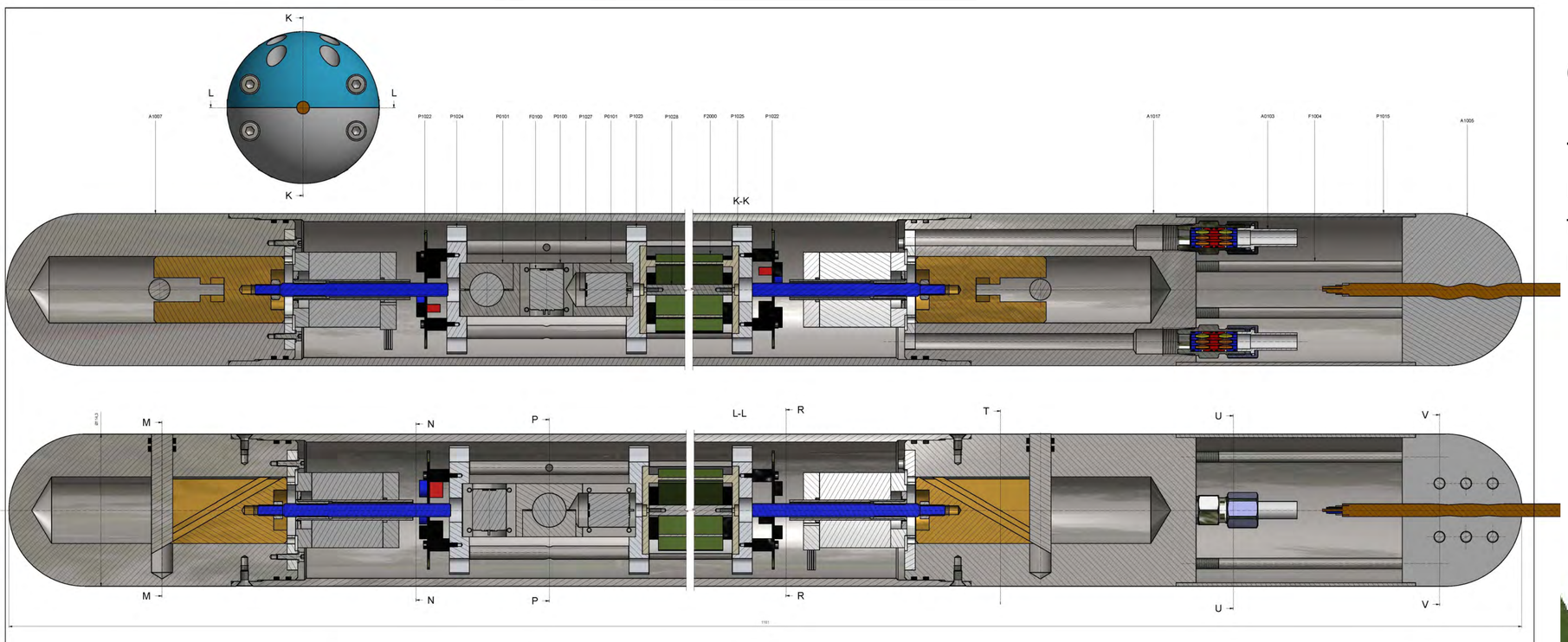
The seismometer is blocked inside the borehole using two deployable fingers that press the steel casing laterally against the borehole. The design is such that the risk of getting stuck in mud or small stones is minimized. Also, a predefined breaking point is foreseen, so that the seismometer can be withdrawn from the borehole by strongly pulling its suspension cable.



5. High pressure compatibility

The seismometer casing withstands high pressures by its circular form. Inside, ambiant pressure as on surface is maintained in the sensor and electronics compartments. Cable pass-throughs are specifically designed to accommodate the pressure difference and are water proof.





Aussen-Ø ca.115 mm
Länge ca.1180 mm
Gewicht ca. 50 kg

Pos	Quantité Menge	Matière Werkstoff	Désignation / Caractéristiques Bezeichnung / Merkmale
P1035	1	Acier inoxydable	Tube
P1036	1	Acier inoxydable	Tige_Cannette_Electronique
P1027	4	Acier inoxydable	Tige_10mm
P1026	4	Acier inoxydable	Tige
P1025	1	Polystyrène	Pièce_Support_2
P1028	1	Polystyrène	Pièce Support 1
P1023	1	Polystyrène	Plaque_Alternateurs
P1022	2	Divers	Stabilisateur-Cône
P1015	1	Acier inoxydable	Bague
P0101	3	Acier inoxydable	Bride
P0100	1	Acier inoxydable	Support_Capteur
F2000	1	Divers	Electronic_Cannette
F 1004	12	Acier inoxydable	Vis M6x12_BT_CM 7991
F 1007	4	Acier inoxydable	Vis M6-10 DIN 913
F 1004	4	Acier inoxydable	Vis M5 x 20 ISO 4762
F 1003	12	Acier inoxydable	Vis M3x30 ISO 4762
F 1002	4	Acier inoxydable	Vis M8x30 DIN 913
F 1005	6	Acier inoxydable	Vis M5x30 ISO 4762
F1100	3	Divers	Capteur_Sismique
A1017	1	Divers	Ensemble_Broquage_1
A1007	1	Divers	Ensemble_Broquage_1
A1005	1	Divers	Ensemble_Serrage_Cable
A0103	2	Divers	Ensemble_Passage_Cable_Complet

Sismomètre II
Ensemble avec système de blocage

Dessiné Gezeichnet: Christian Cachelin, 05.05.2016
Contrôlé Geprüft:
Echelle Massstab: 1:1

Fichier Datei:

Hes·so VALAIS WALLIS

A1013

6. Installation tripod

The seismometer is deployed using a tripod hoisting assembly that can be rapidly installed and removed from the borehole.