Development and Application of Metal Casing Packers in the Soultz Boreholes

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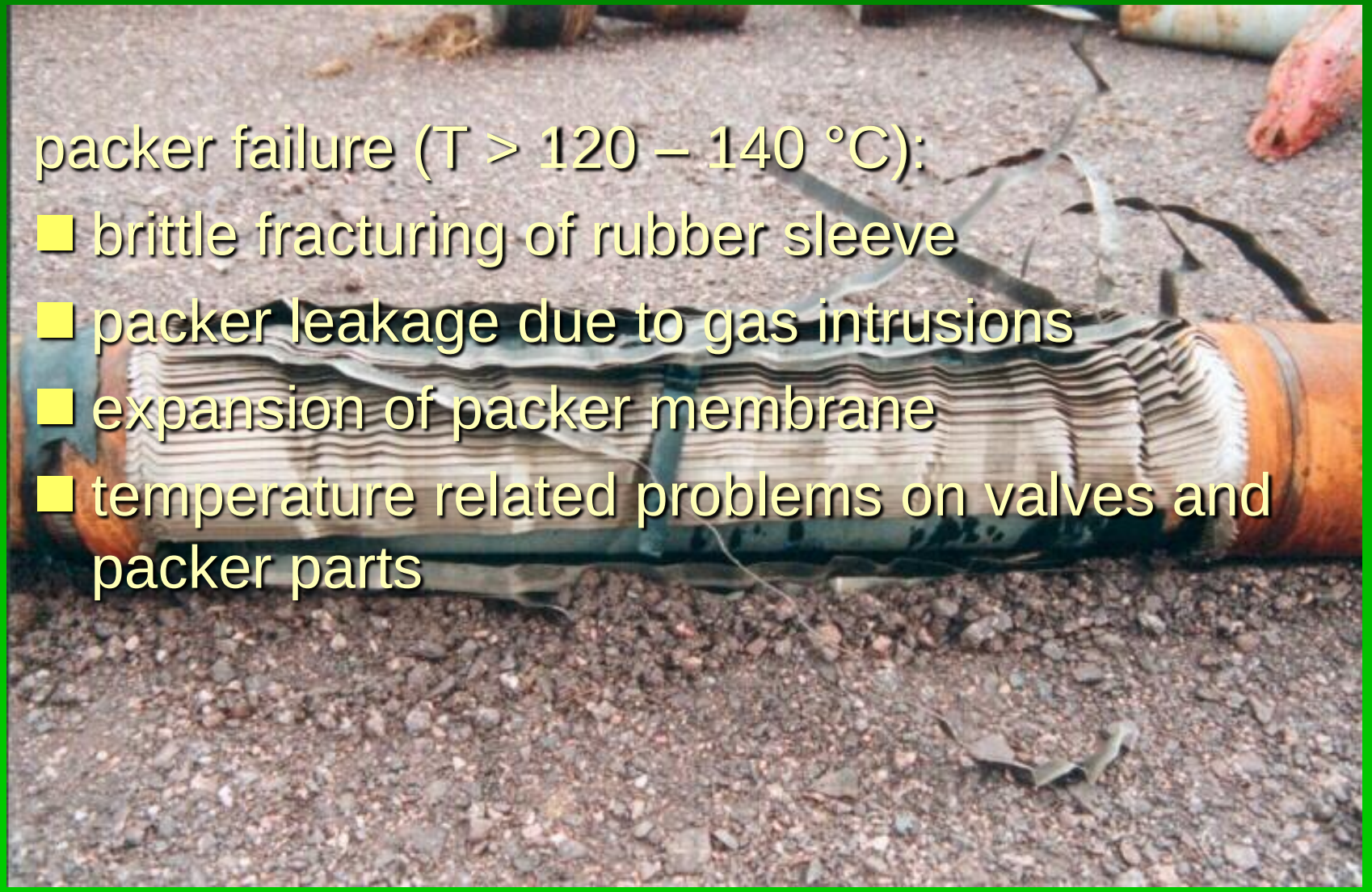
Conventional Casing Packer

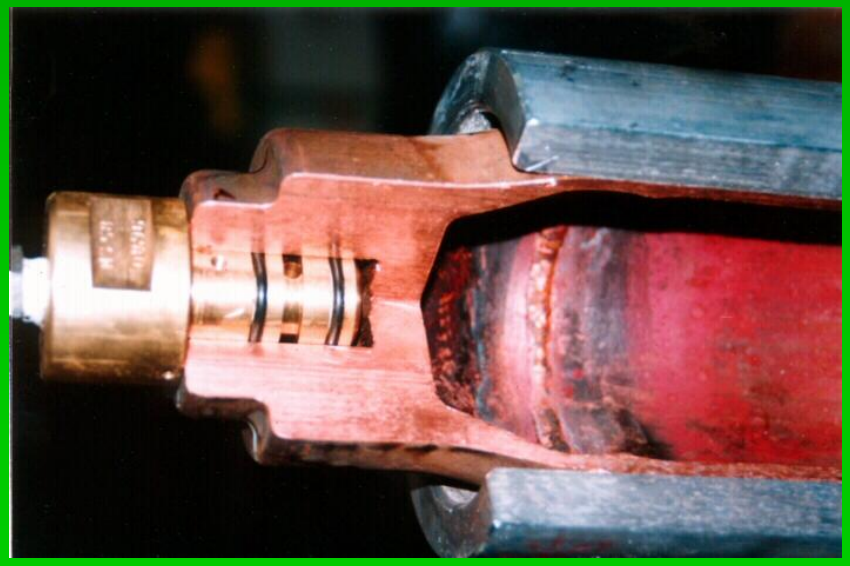


packer failure (T > 120 – 140 °C):

- brittle fracturing of rubber sleeve
- packer leakage due to gas intrusions
- expansion of packer membrane
- temperature related problems on valves and packer parts

Aluminum Packer for Hydrofrac / Hydraulic Tests

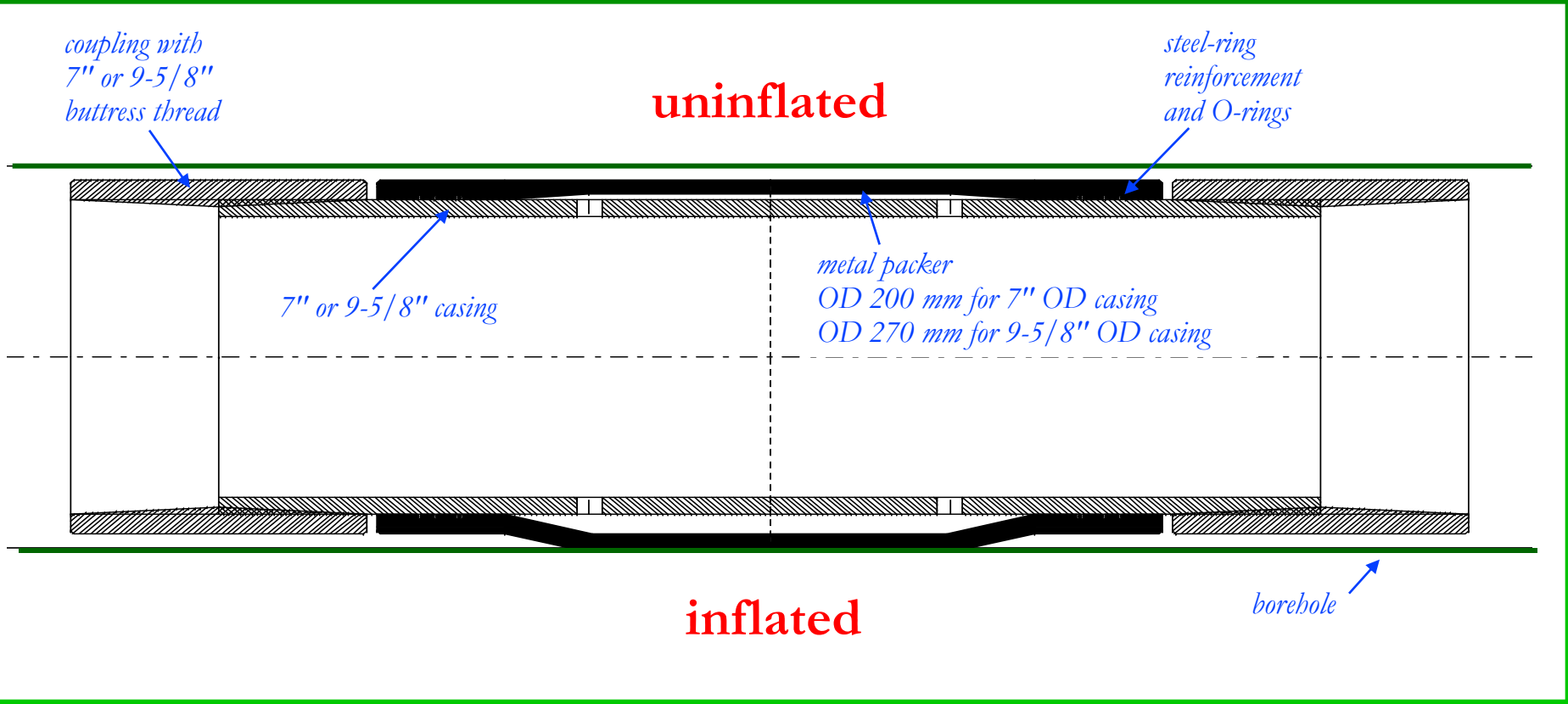
Copper and Stainless Steel Packer for Permanent Borehole Sealing



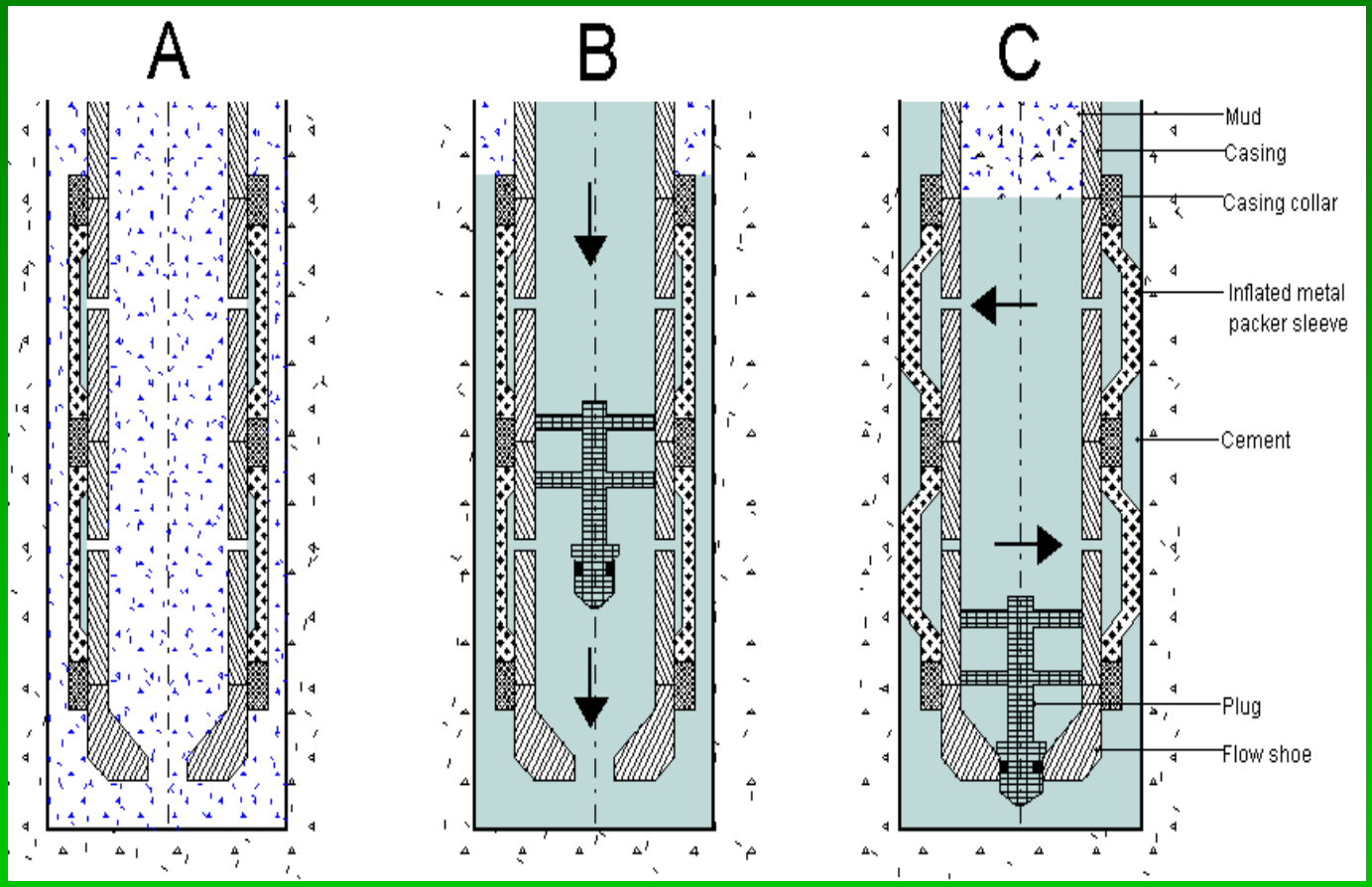
Metal Packers for Casing Cementation: Requirements in Soultz Boreholes

- permanent and reliable sealing of the casing at about 4.5 km depth (temperature: 180-200 °C)
- support the full weight of the casing string (> 150 tons)
- withstand the hostile downhole conditions for more than 20 years
- designed as simple and sturdy as possible

Design of CuNi Casing Packer

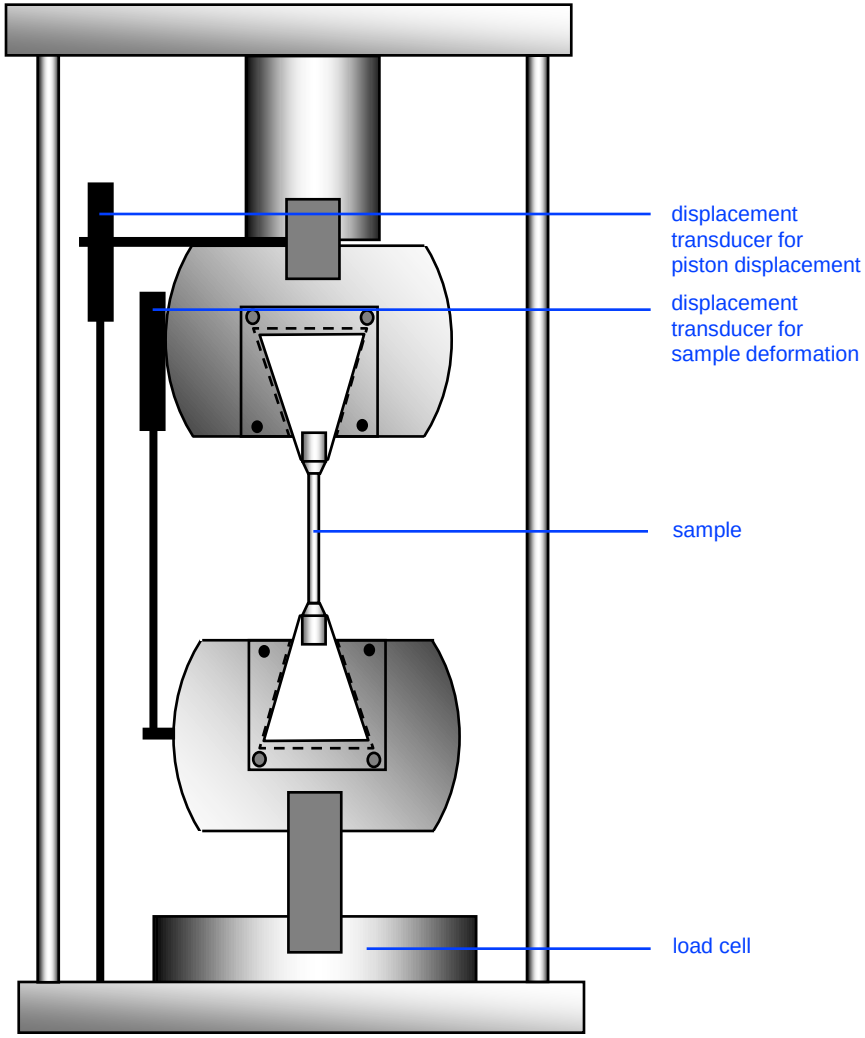


Principle of Casing Cementation with Metal Packer



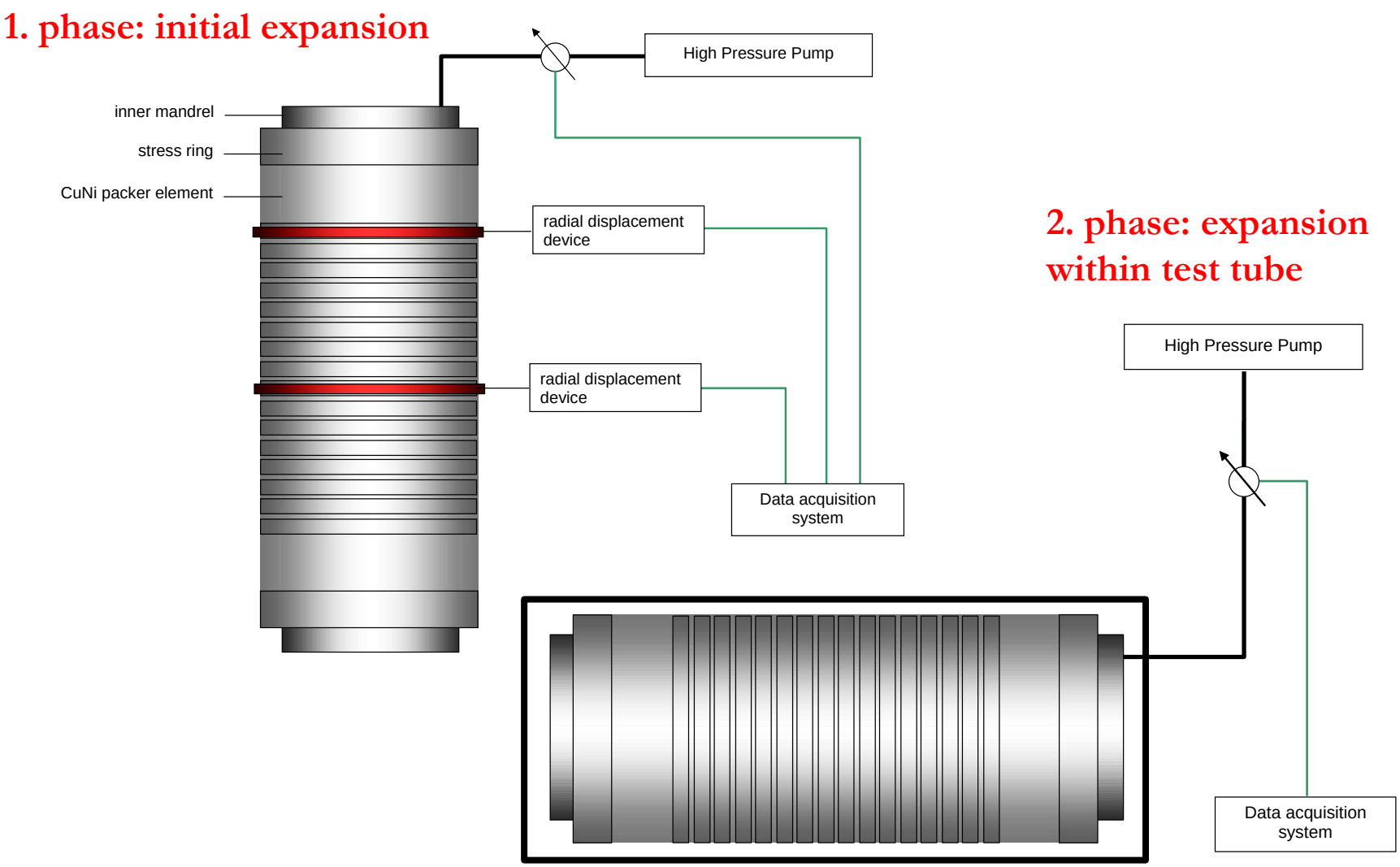
- trip-in casing with inflatable metal casing packers (A)
- pump down cement, followed by plug (B)
- close float shoe and inflate metal packer sleeves by increasing the pressure inside the casing (C)

Material Characterization

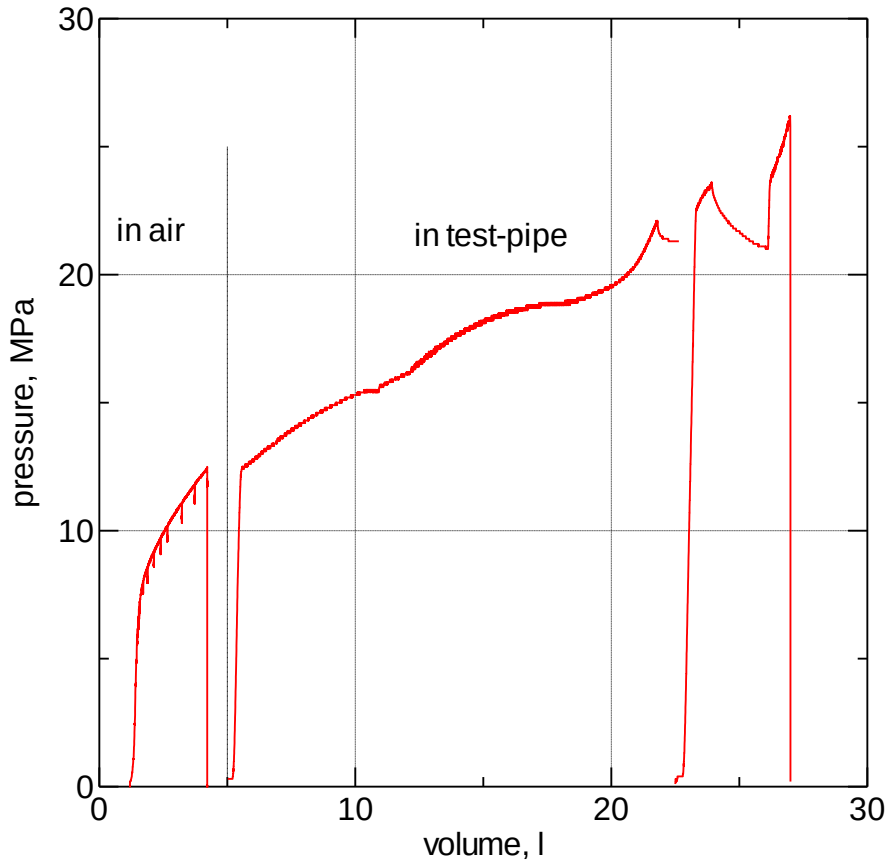


- maximum strength $\sigma_{max} \approx 300$ MPa
- yield strength $\sigma_d \approx 170$ MPa
- maximum deformation $\varepsilon \approx 40$ %

Laboratory Testing of OD 270 mm Packer Elements

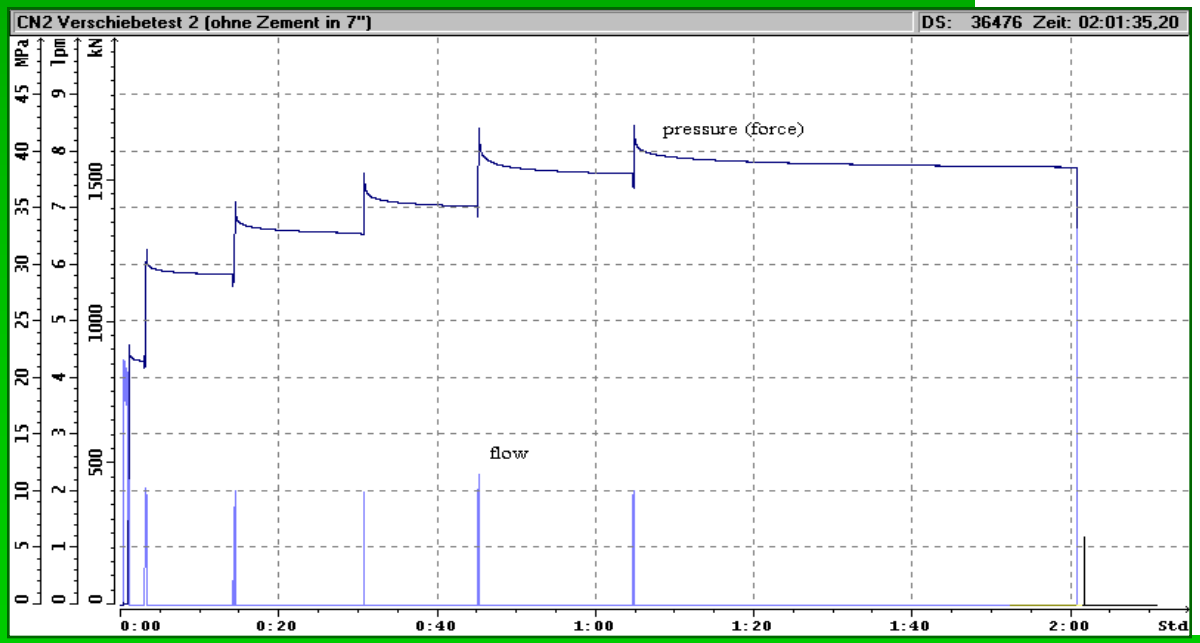


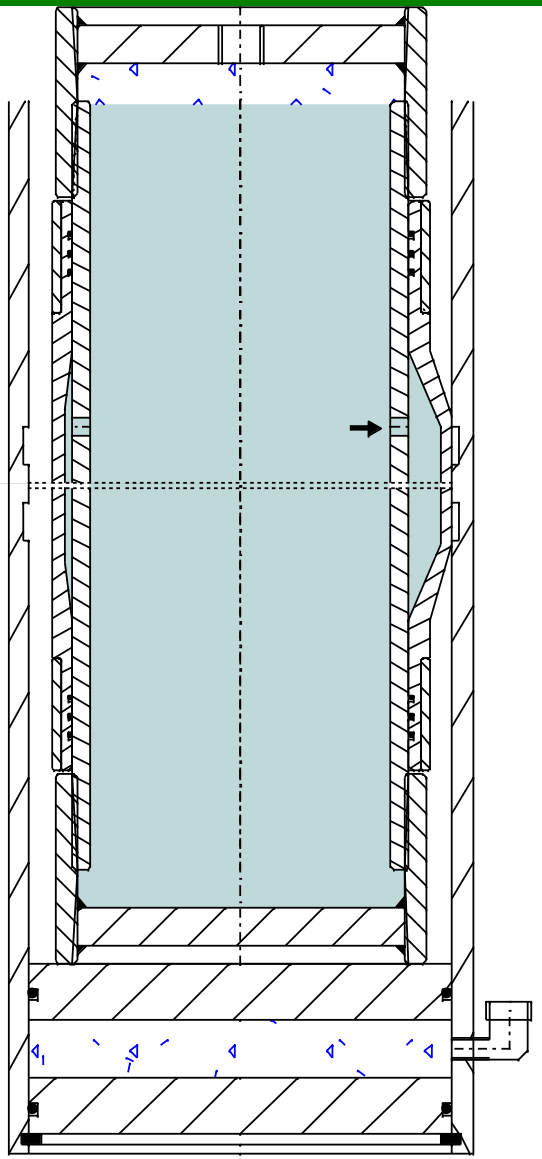
Laboratory Testing of OD 270 mm Packer Elements



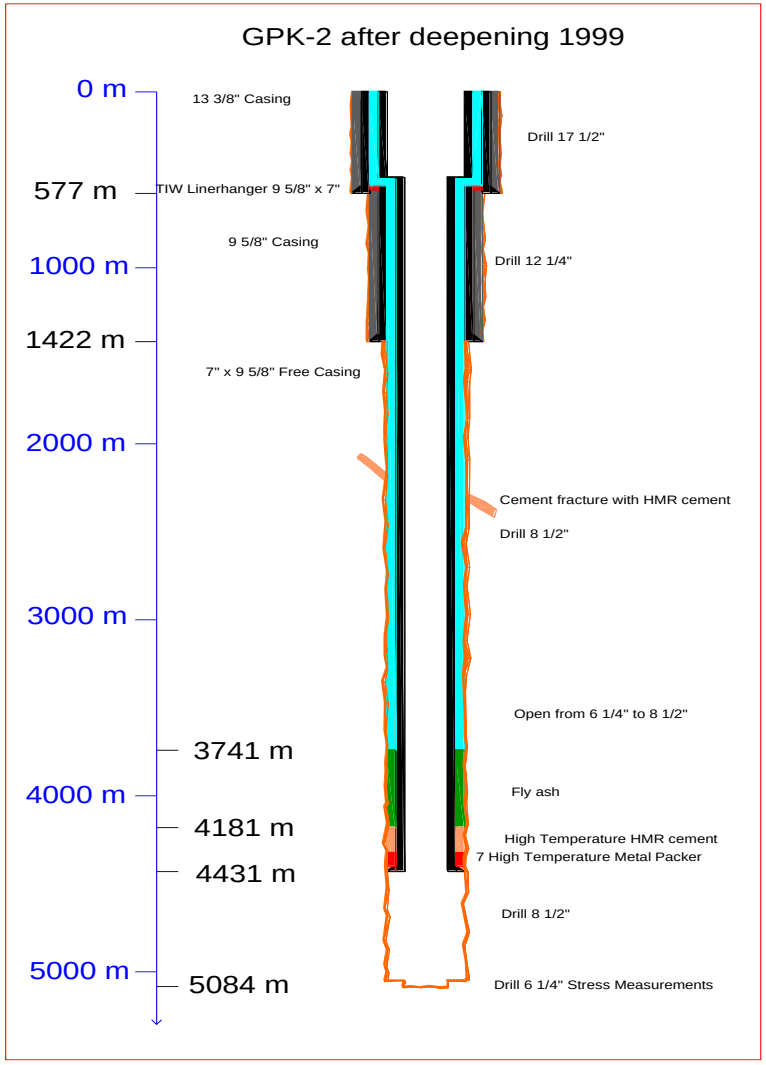
Laboratory Testing of OD 270 mm Packer Elements

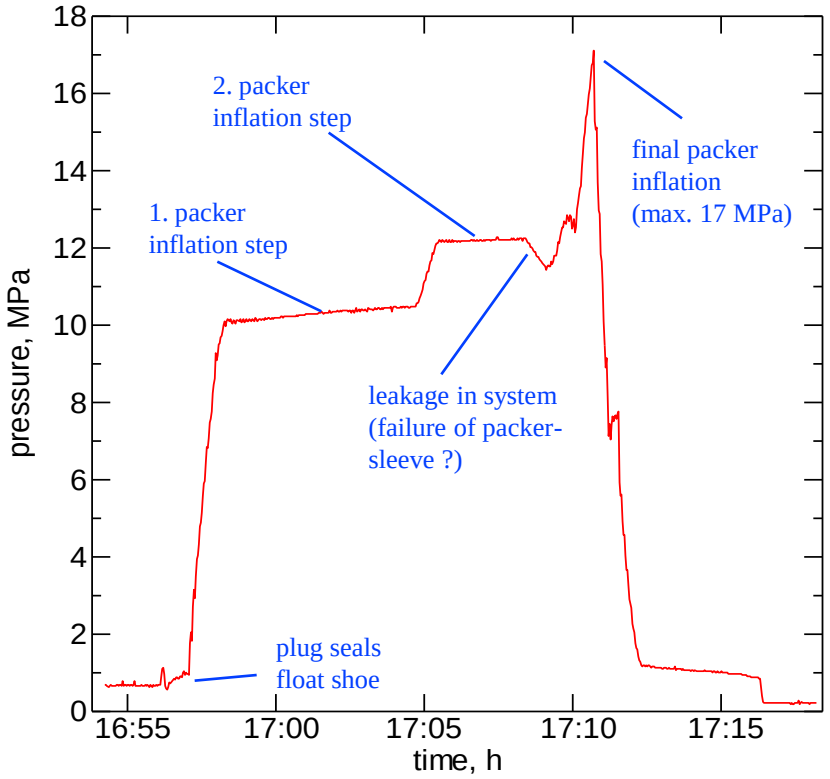
Laboratory Testing of OD 200 mm Packer Elements



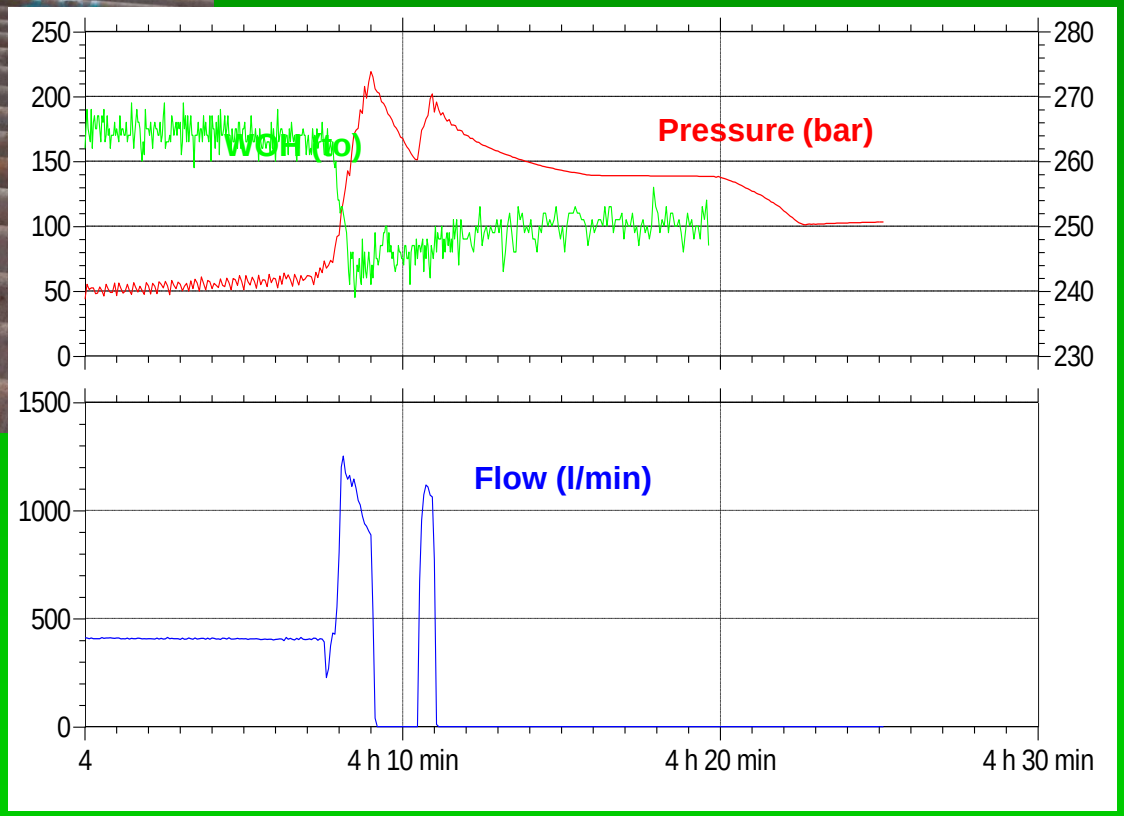


Casing Cementation in Borehole GPK-2 (1999)





Casing Cementation in Borehole GPK-3 at 4556 m MD & GPK-4 at 4756 m MD (2002/2004)



Summary & Conclusions

- New casing packer technology based on ductile CuNi packer elements was developed and applied at great depth with high temperature and hostile downhole conditions.
- Present technology is available for 7" and 9-5/8" diameter casing, but can be modified to other sizes.
- Other applications (e.g. whipstock packers, bridge plugs) are possible.
- PATENT (no. PCT/FR-00/00784)