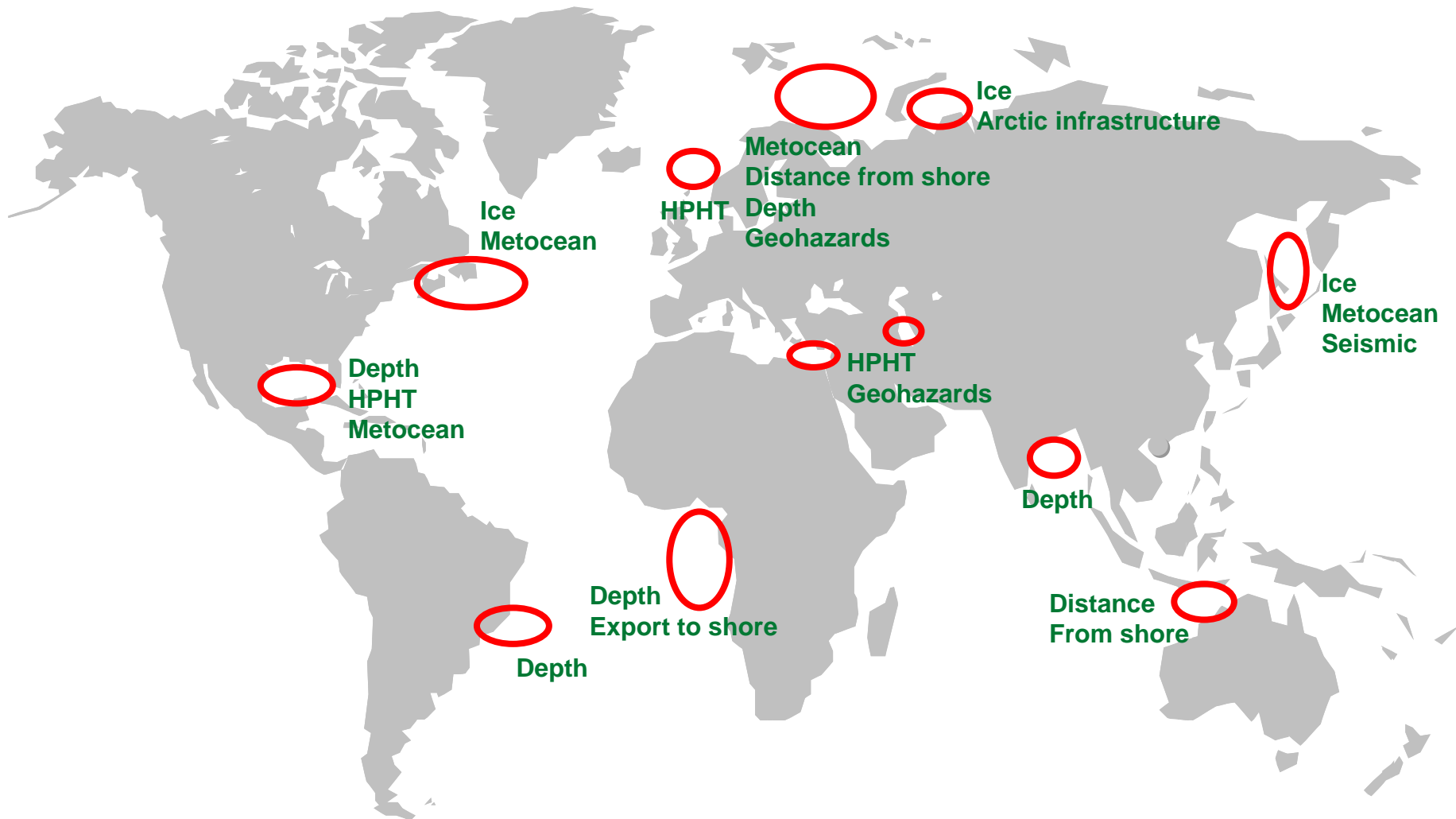




Challenges of offshore gas developments

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IGU Working Committee No 1 – Exploration & Production

Offshore frontiers for gas and associated gas developments



Gas export in deepwater developments



DCV Balder



- Weight of large diameter DW export risers challenges materials performance, installation capability and connections to floating structures
- Technology opportunities for:
 - more fatigue resistant and lighter materials
 - better flexible couplings
 - installation vessels more robust to conditions

High pressure high temperature developments



The Thunderhorse PDQ on its way to the Gulf of Mexico. HPHT conditions are ~1000bar and ~120°C

- Some DW developments are encountering new limits for HPHT from floating structures
- Technology opportunities in deepwater HPHT for:
 - subsea BOPs
 - subsea HIPPS
 - 1400bar/180°C wellheads
- ‘Deep gas’ prospects at over 10,000m in shallow water Gulf of Mexico

Arctic and cold region developments



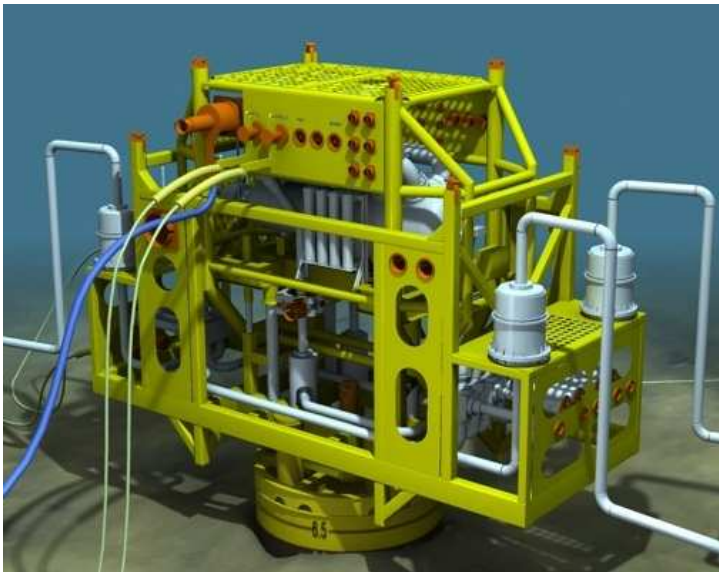
Kulluk ice resistant drilling rig in Beaufort Sea

- Limited Industry capability in heavy ice conditions
- Successful exploitation of offshore gas will require:
 - Extensive environmental data collection
 - New offshore concepts for ice and seismic loads to extend drilling and production season
 - Ice resistant GBS structures for shallow water
 - Mooring, thruster and intervention strategies for floating structures in deeper water
 - Emergency response and evacuation
 - Gas export strategies, and infrastructure investment

Flow assurance and subsea processing



Hydrates in Mungo 16" gas export line



King subsea multiphase pumping unit

- Industry flow assurance methods challenged by cold, high pressure environments (multi-phase flow, temperature measurement and prediction, liquid management and hydrates)
- Continued development of non-thermodynamic hydrate inhibitors/anti agglomerants
- Subsea pumping is being deployed by the Industry, with subsea gas compression and separation to follow
- Comprehensive capability for very long distance tie-backs being created

Key challenges for offshore gas developments



Deepwater

- **Gas export in deepwater**
- **High Pressure High Temperature**

Arctic/Cold Region

- **Extending drilling & production season**
- **Emergency response**
- **Gas export strategies**

- **Flow assurance in cold, high pressure environments**
- **Subsea processing, and long distance tie-backs**