



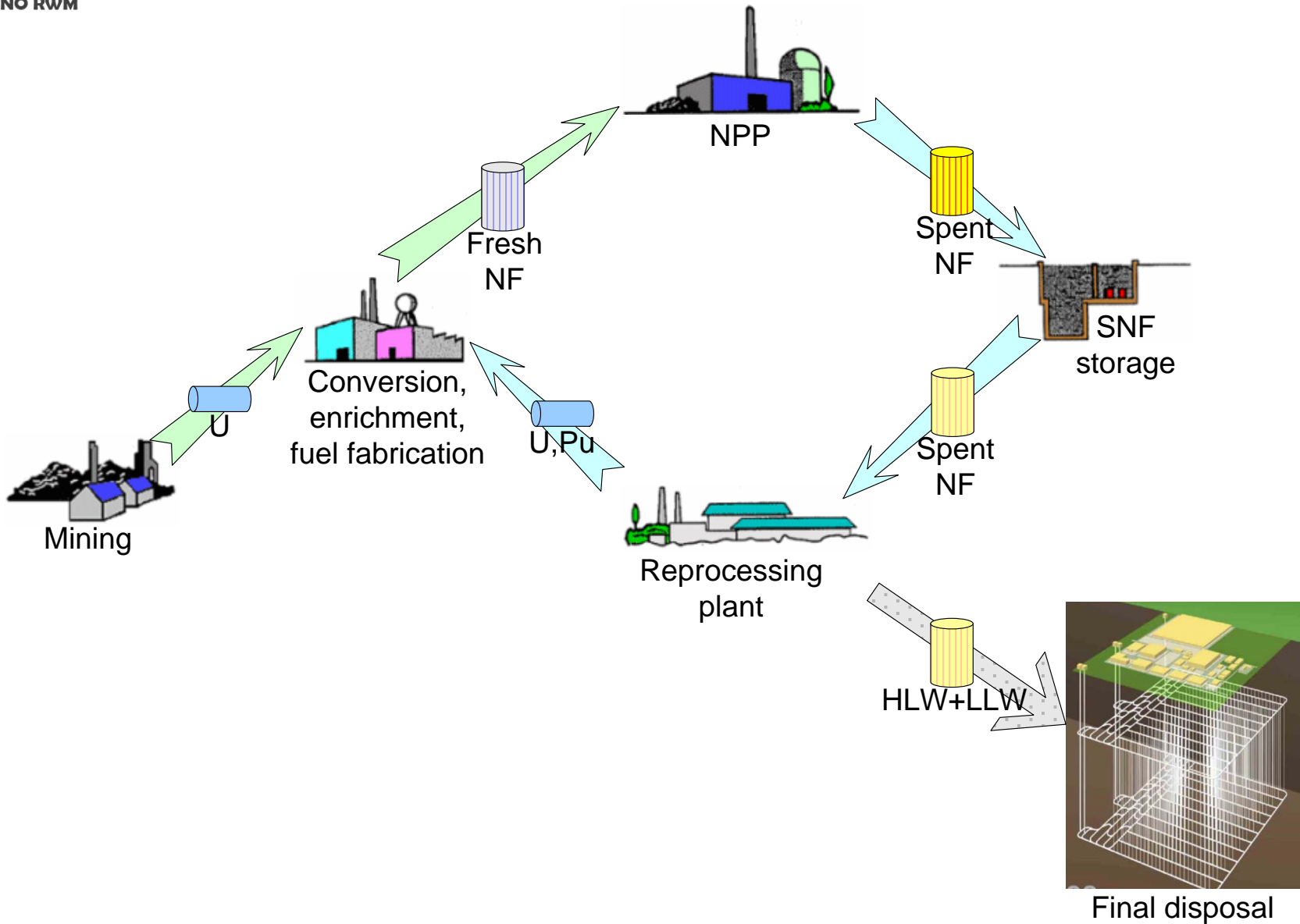
THE FEDERAL STATE UNITARY ENTERPRISE
«NATIONAL OPERATOR FOR RADIOACTIVE WASTE MANAGEMENT»

Difficulties of monitoring in rock formations

Vsevolod Igin, Vladimir Kononov

***Monitoring in geological disposal
of radioactive waste
09-11 April,
Paris, France***

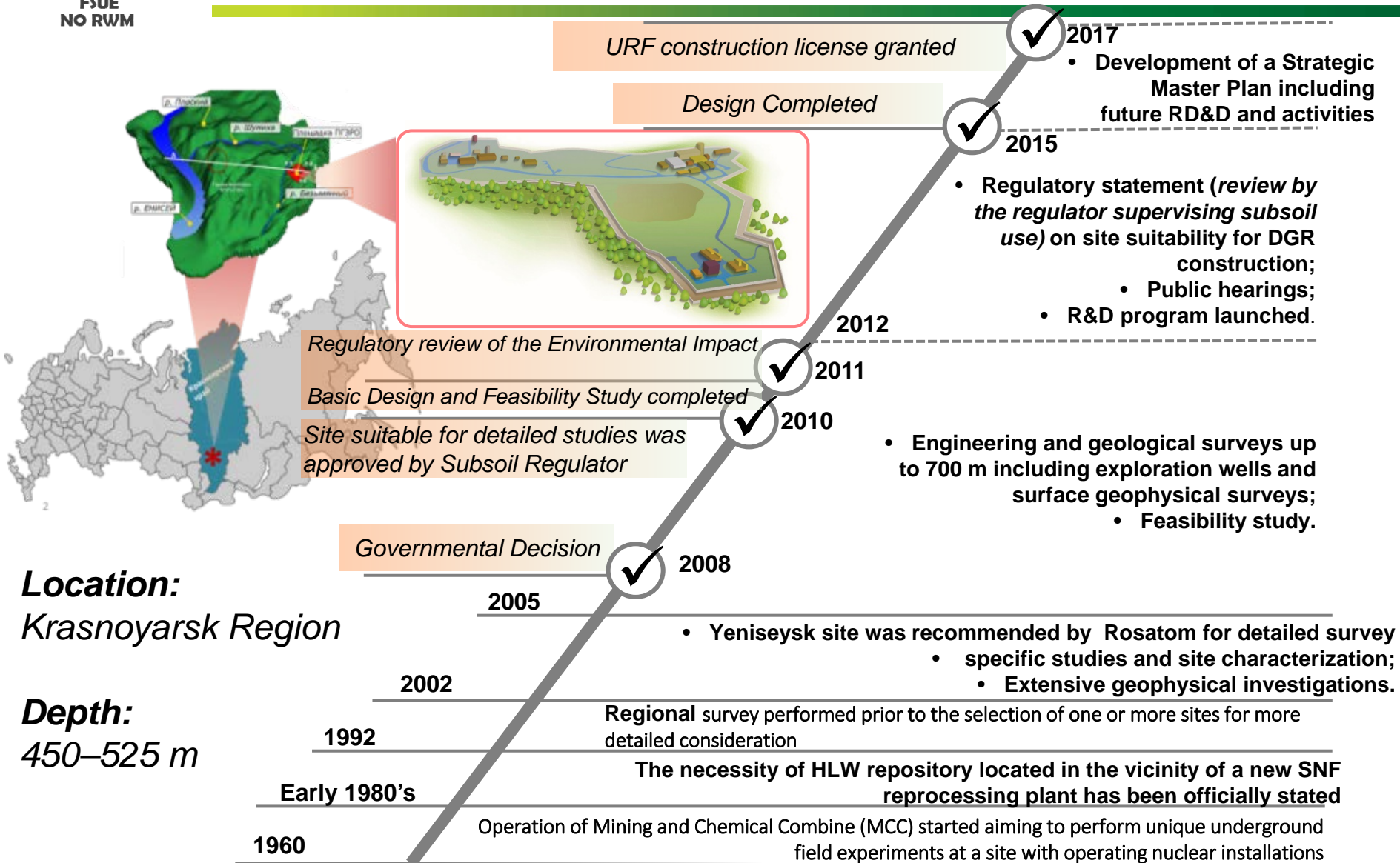
Russia has closed nuclear fuel cycle concept





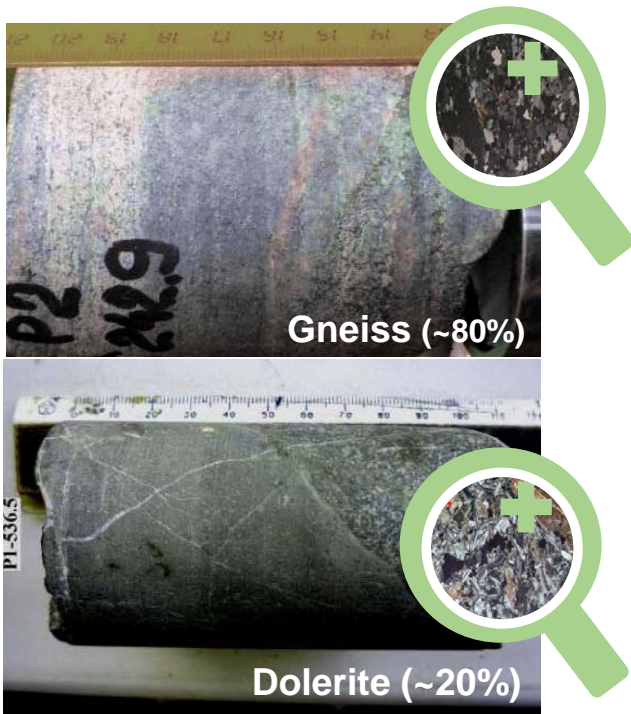
FSUE
NO RWM

Russia's Geological Disposal Timeline



Status of the disposal facility program

- Site selection stage completed
- Construction of the underground research laboratory has started
- Disposal monitoring program is being planned now



- Metamorphic gneiss penetrated by dikes
- Fractures are completely sealed due to secondary mineral forming
- No active tectonic faults
- High stability of the rock massive



Monitoring aspects



Geosphere

- groundwater
- stresses



Biosphere

- environmental
- population
- staff



Features, events, and processes

- weather
- seismic/tectonics
- technogenic
- etc.



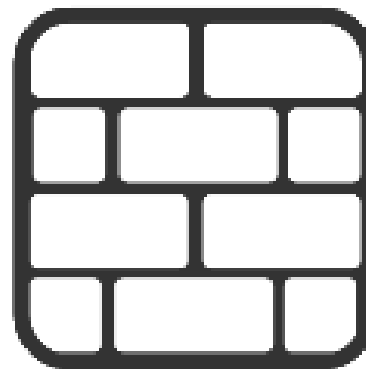
RW

- RW condition
- WAC eligibility
- package condition



Equipment

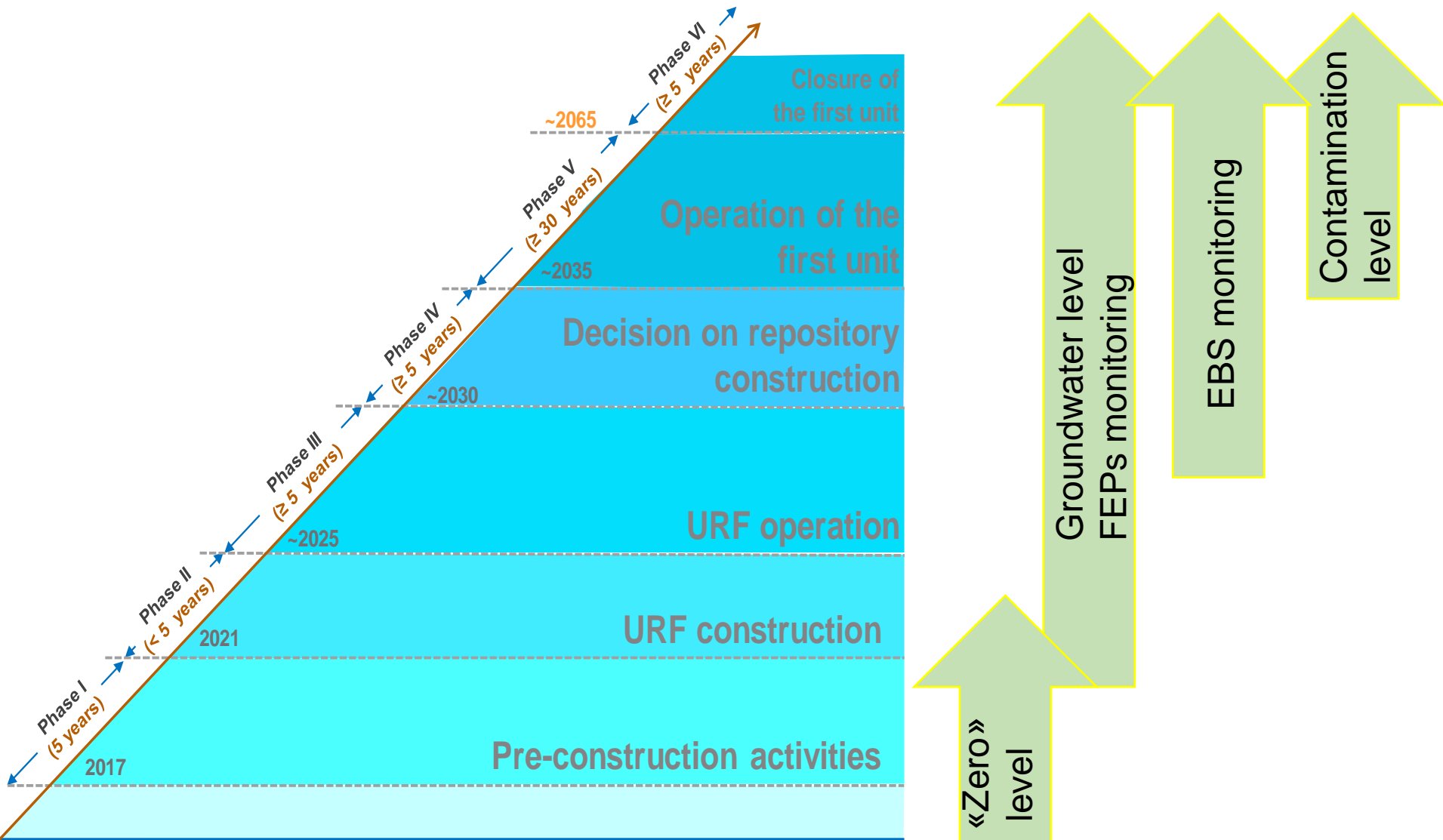
- limit states
- black box
- residual life
- etc.



Engineering barrier system

- thermodynamic
- physicochemical
- offsets

Monitoring of whole life-cycle process

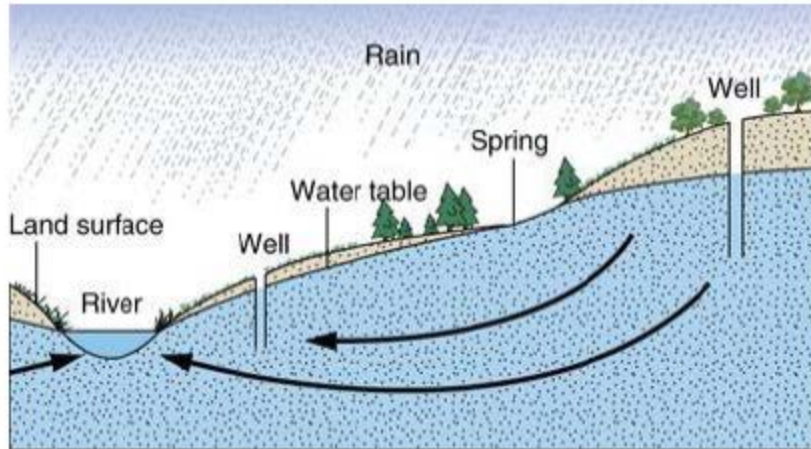


Countries, which have selected rock mass for disposal face same difficulties during monitoring: Common reason is **heterogeneity of permeability**

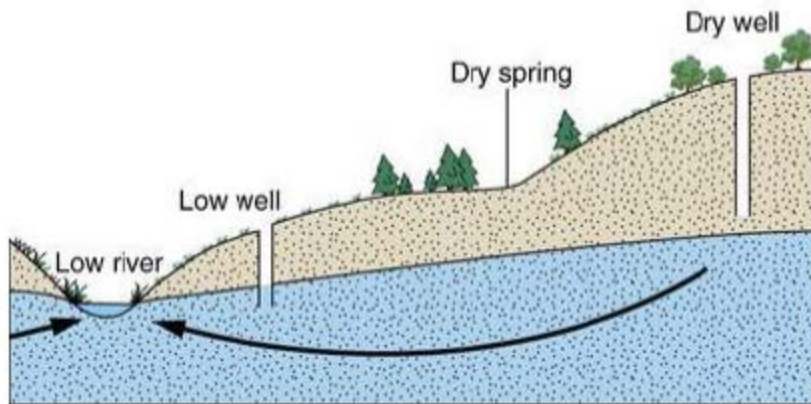


Difficulty #1

FSUE
NO RWM

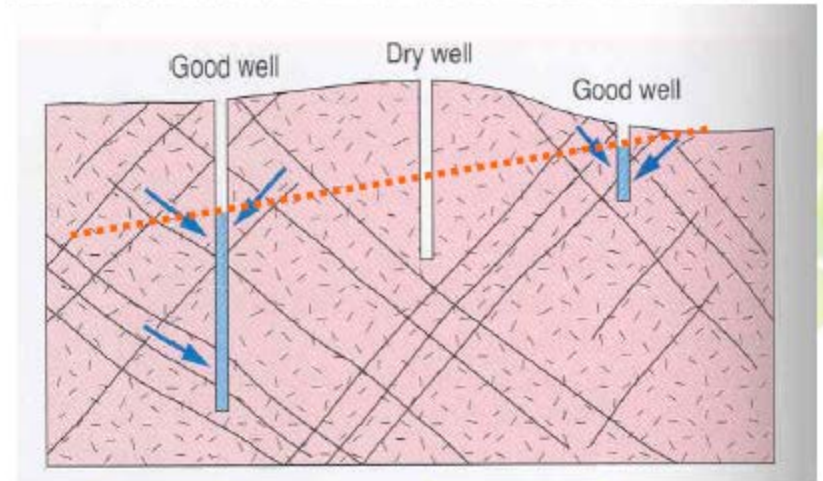
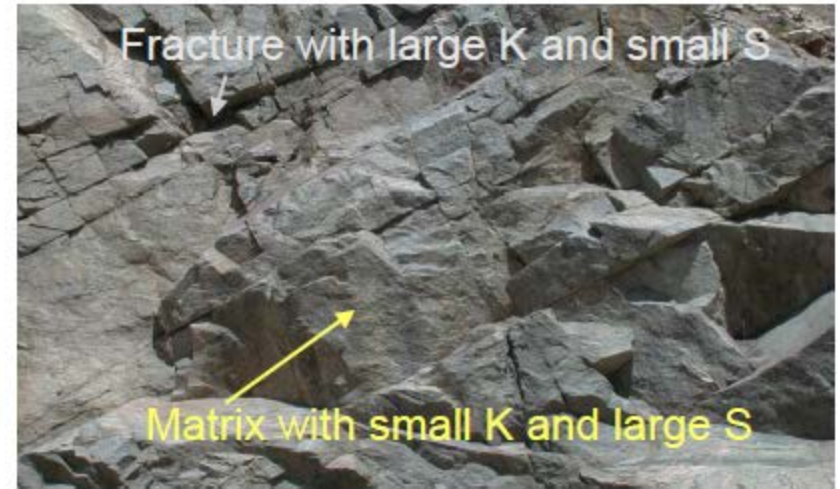


A



B

Porous medium aquifer

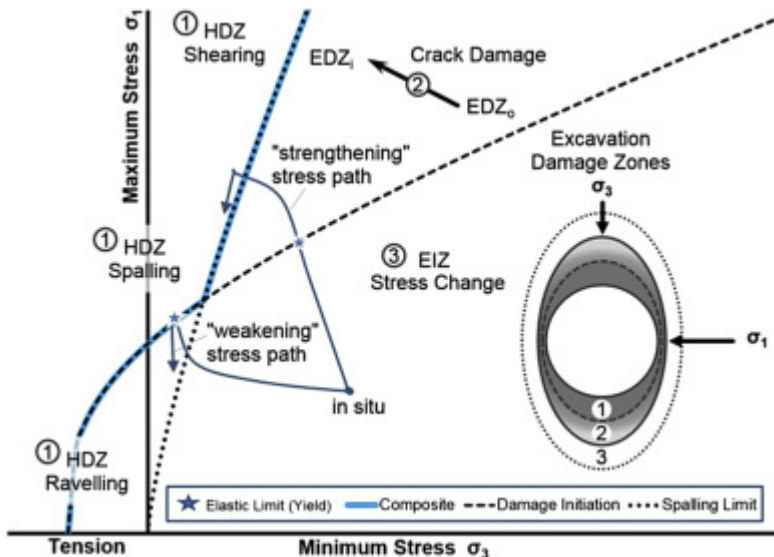


Fractured rock aquifer

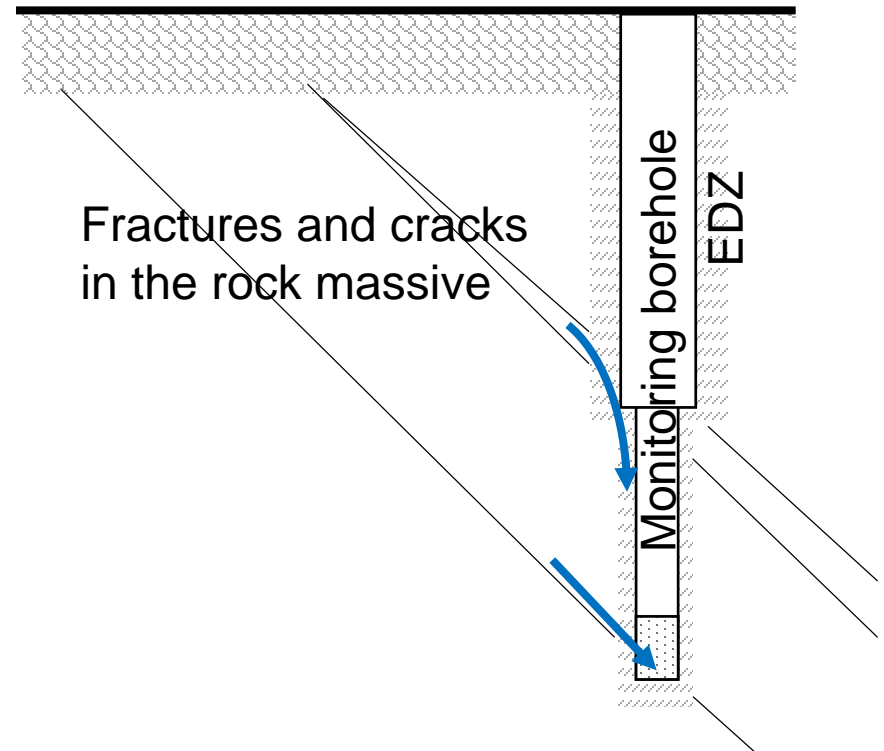


Difficulty #2

Monitoring boreholes as any other excavations have excavation damage zone (EDZ), where filtration is comparable to filtration in cracks

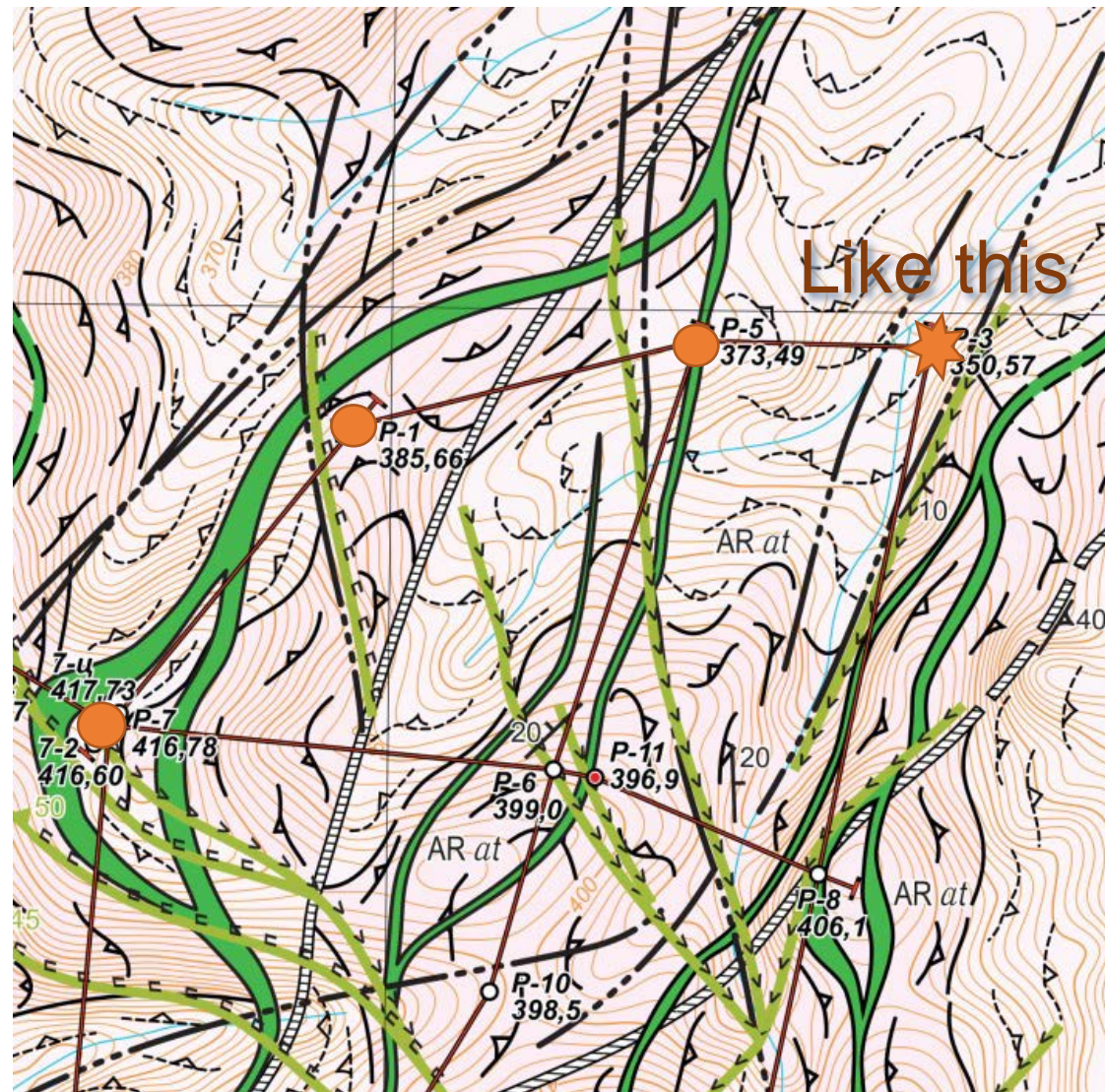


Predicting excavation damage zone depths in brittle rocks
Matthew A.Perras Mark S.Diederichs Canada, Switzerland
<https://doi.org/10.1016/j.jrmge.2015.11.004>



Difficulty #3

In any case, there is no evidence that a high-conductive fracture or crack does not pass near the monitoring borehole, as well as they do not intersect it.



Skepticism

Thus, no monitoring network in rocks can be considered as convincingly justified.

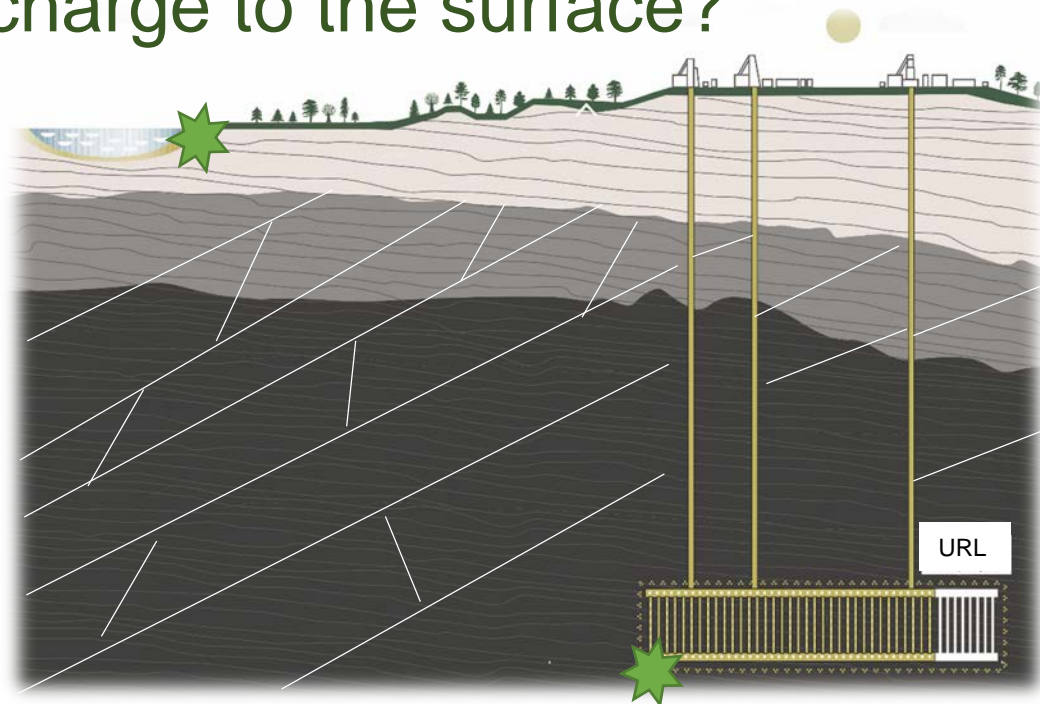
Financing of monitoring program in geosphere should be evaluated under skeptical approach, considering that it's results are dubious and cannot convince anyone on anything?



What to do (1)?

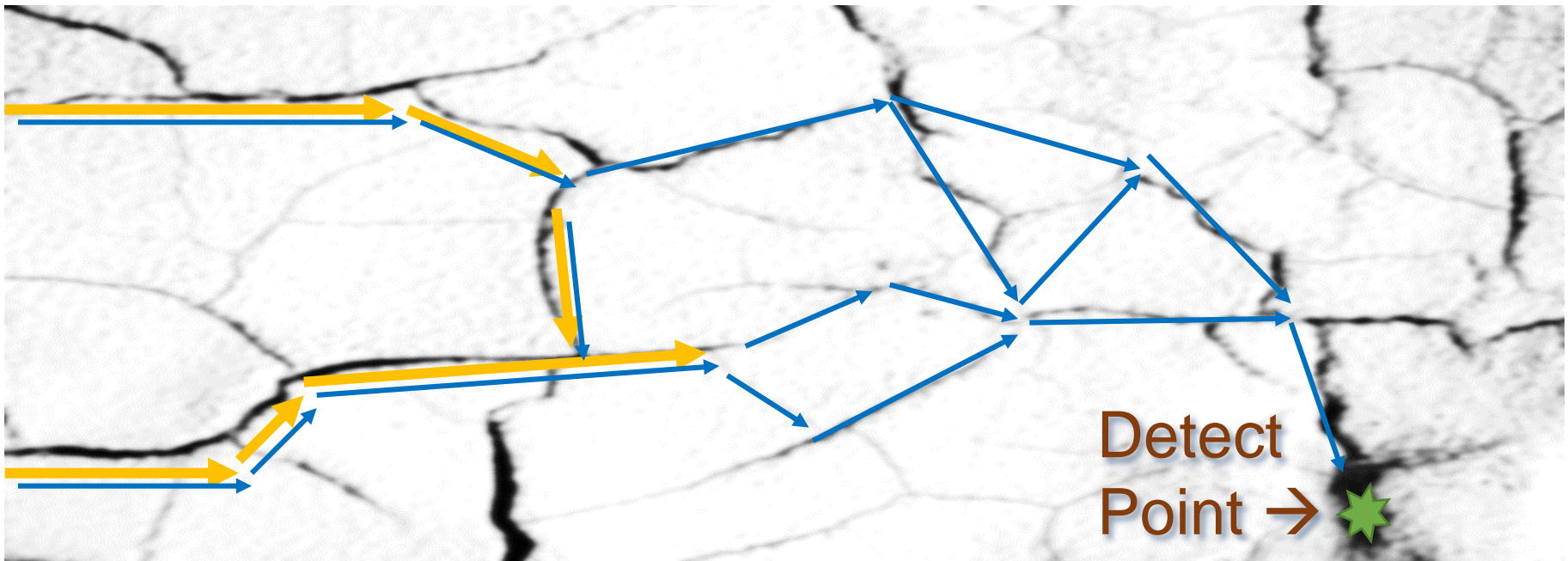
Perhaps a better strategy is to monitor key points which pollution cannot circumvent?

- ☐ lowest points of facility (drainage wells)?
- ☐ areas of potential discharge to the surface?
- ☐ other ideas?



What to do (2)?

Maybe it will be helpful to use special marker (**blue arrow**), disposed with the radwaste, which will be ahead of the potential migration of pollution (**orange arrow**) and will be easily traced in small concentrations?



1. Decision on reasonable amount of monitoring in the rock formations
2. Special equipment for monitoring in rock massive
3. Other possible monitoring strategies-in replacement or in addition to existing ones?

Thank you for your attention!

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