# Uranium Extraction in Central Asian Republics

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NATO SfP Project

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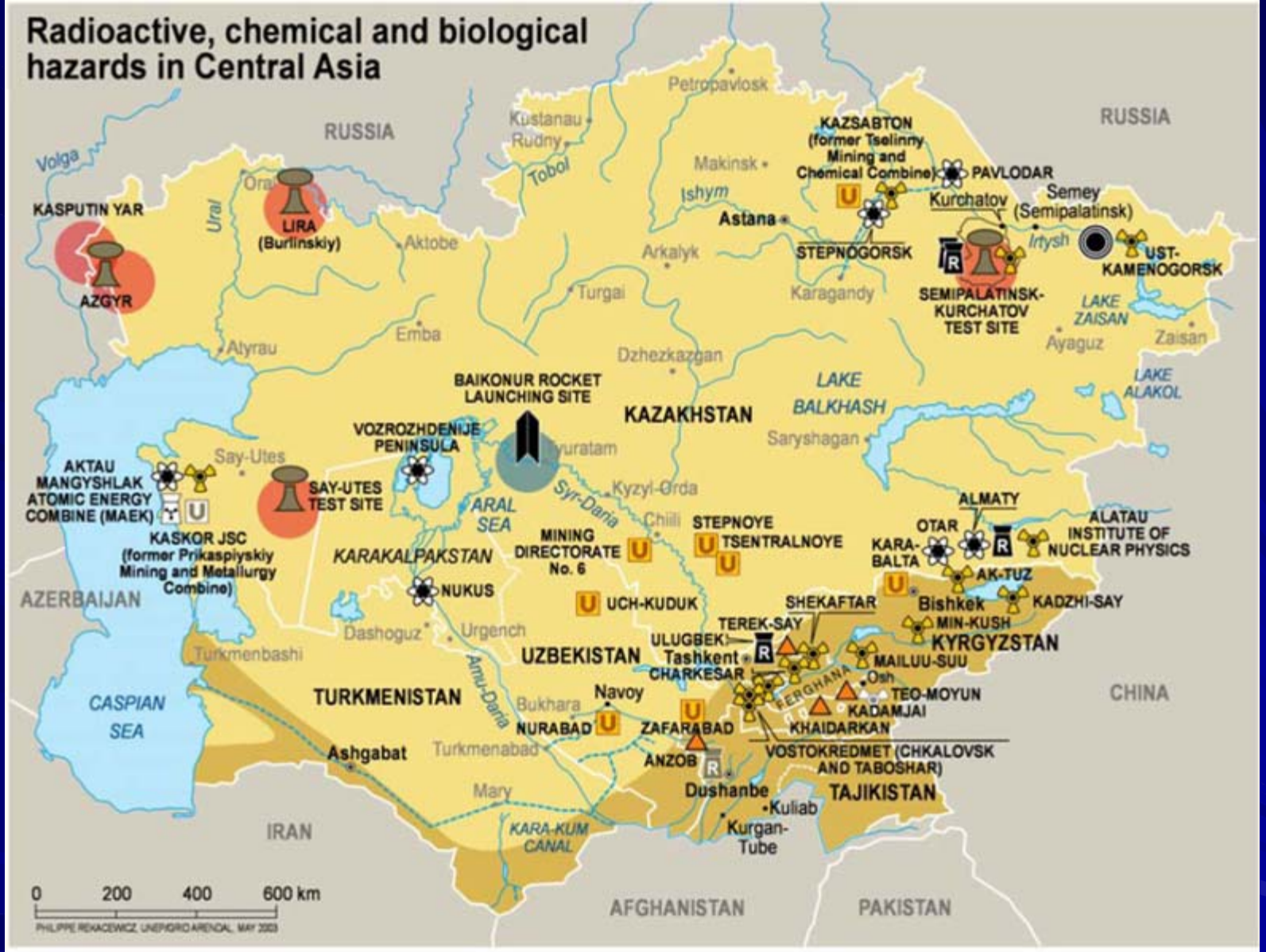
# Central Asian States
# Aral Sea Basin

# Radioactive, chemical and biological hazards in Central Asia




Former nuclear test site. Large portion of surrounding areas contaminated.

**Nuclear power plant**

Power reactor

Active

Closed

Research reactor

Cosmodrome and rocket launching site. Important environmental impact on the surrounding areas

Uranium mining and milling facility. Radioactive waste related to exploitation

Closed uranium mine

Radioactive waste storage site generally poorly maintained, and alleged to pose a significant risk to health and environment

Old radioactive waste site (early 20th century)

Fuel production

Non-radioactive waste site (mercury, antimony)

# Uranium Legacy Issues

Uranium mining and processing of radioactive ores resulting in huge amounts of radioactive tailings and waste rock deposits in CA countries – over 800 M tonnes, 64 $km^2$ affected land

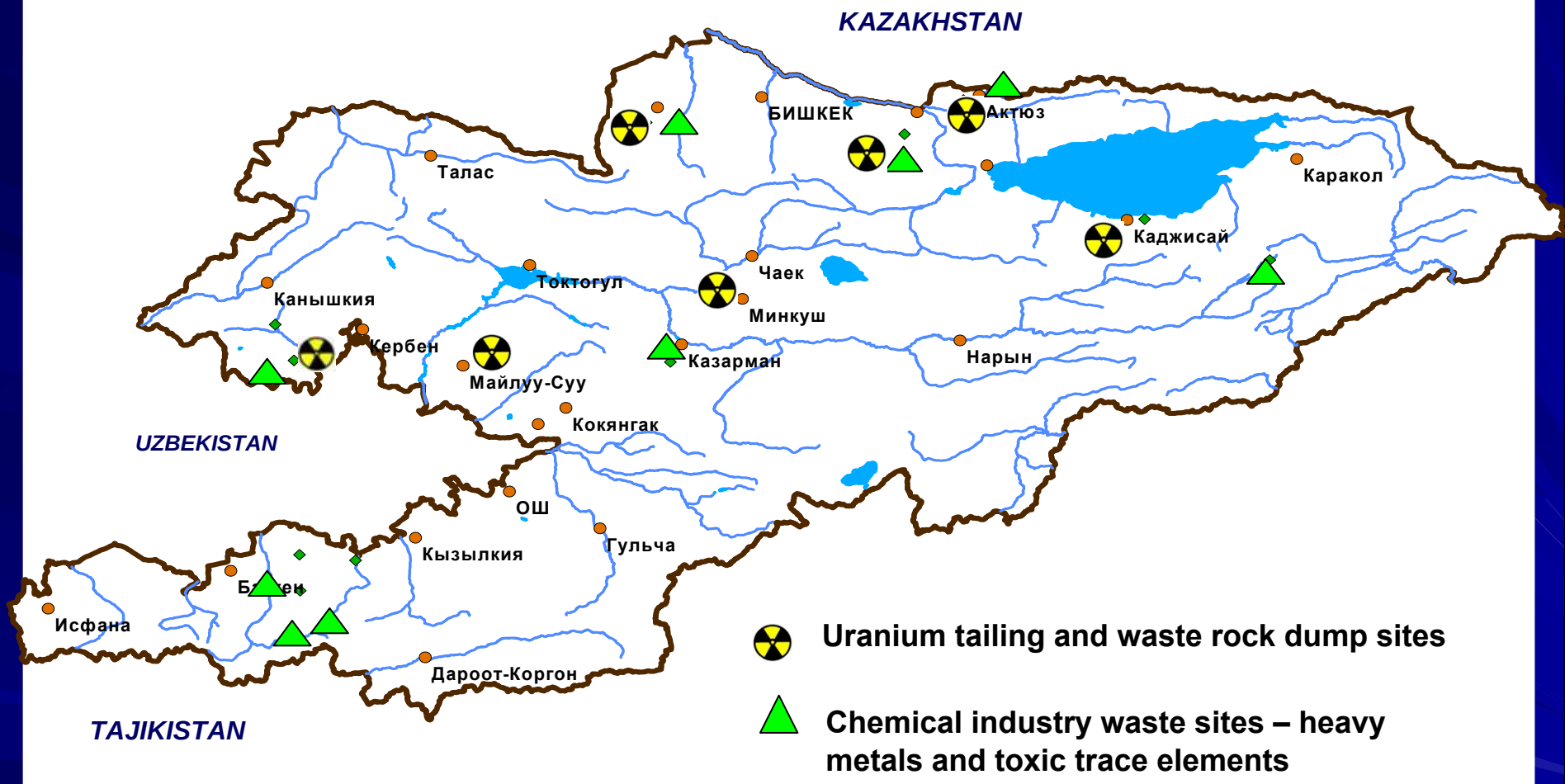
Potential impact on human health and environment in transboundary context

# U Legacy Related Problems

- Uranium legacy sites in inhabited areas prone to natural disasters
- Majority of sites not properly managed due to lack of money and inadequate regulatory infrastructure
- Low living standard of resident populations, health and social problems, migration, etc.
- Concern of resident population due to lack of information

# Hazards

- Radioactivity
  - Gamma, alpha + Rn doses
  - Drinking water/food intake
  - Particles/aerosols
  - Ecosystem transfer
- Metals – levels, transport, uptake
- Multiple stressor exposures
- Geohazards: earthquakes, landslides, flooding – physical risk



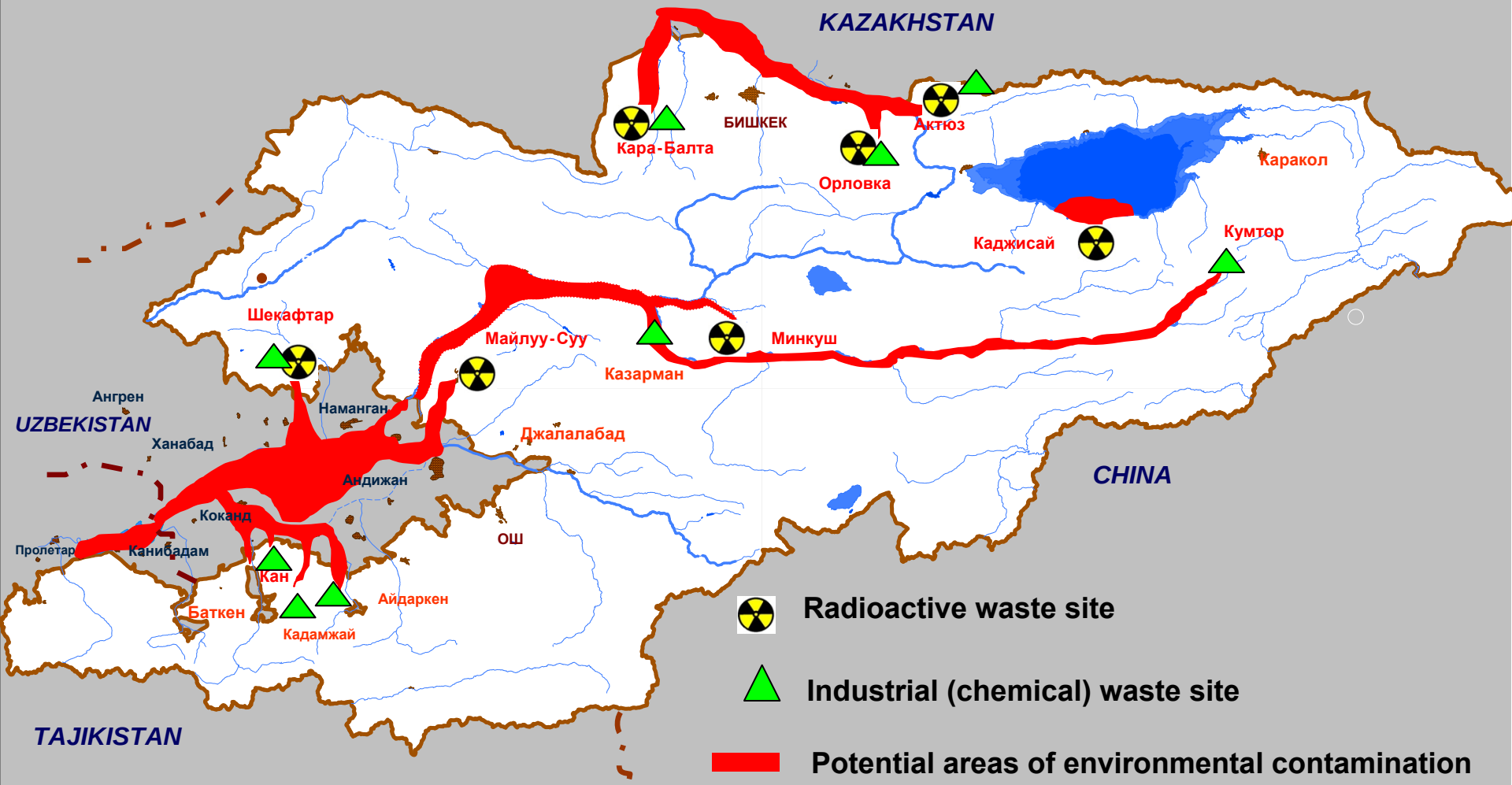

Uranium tailing and waste rock dump sites

Chemical industry waste sites – heavy metals and toxic trace elements

# Оползень « Туюк-Суу »

# Моделирование возможного завала при сходе оползня, образование подпрудного озера и прохождения прорывной волны при размыве плотины

# Площади возможного загрязнения территории Кыргыской Республики и трансграничных республик при разрушении хвостохранилищ




По данным специалистов в настоящее время имеется высокий риск возникновения радиационно-опасных экологических катастроф, в зону возможного загрязнения которых подпадают территории Кыргызской Республики, Казахской Республики, Таджикской Республики и Республики Узбекистан, где проживает около 5 миллионов человек.

# NATO RESCA SfP Objectives:

- Characterisation of the source-terms and determination of local contamination in selected uranium tailing sites
- Radiation dose and impact assessment
- Identification of appropriate mitigation/remediation countermeasures
- The RESCA (Radioactivity Environmental Security in Central Asia), NATO SPS (Science, Peace, Security) project contributed to:
  - upgrading of environmental radioactivity laboratories
  - training of personnel, especially young scientists,
  - use of contemporary equipment, survey methods and protocols,
  - promoting education in radiological protection and identification of immediate and urgent measures for emergency management.

# Uranium mining and tailings in Central Asia: Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan

Kurday site in Kazakhsta

Taboshar site: U tailing pile resulting from the processing of low grade U ore (U content below 0.3%). Estimated volume of tailings over 10 million cubic metres, potential impact on the environment due to air and water erosion processes from the exposed tailings

Degmai U mill tailing site: unremediated area of 90 ha, 30.000 million tonnes of tailings deposited in close vicinity of Khudjand, 350.000 people, capitol of North Tajikistan)

rocess tailings at Taboshar, Tajikistan.

**NATO RESCA + Joint Norwegian project**

**Total 15 field missions:**

- **Kazakhstan 2006: Kurday**
- **Shu River, Kazakhstan - Kyrgyzstan 2009**
- **Kyrgyzstan 2006, 2007, 2008, 2009: Shekaftar, Minkush, Kadji Sai, Orlovka, Ak-Tyuz**
- **Tajikistan 2006, 2008: Digmai, Taboshar**
- **Uzbekistan 2006, 2007: Yangiabad, Charkesar**

# Output: Environmental Impact Assessment associated with radioactivity to man

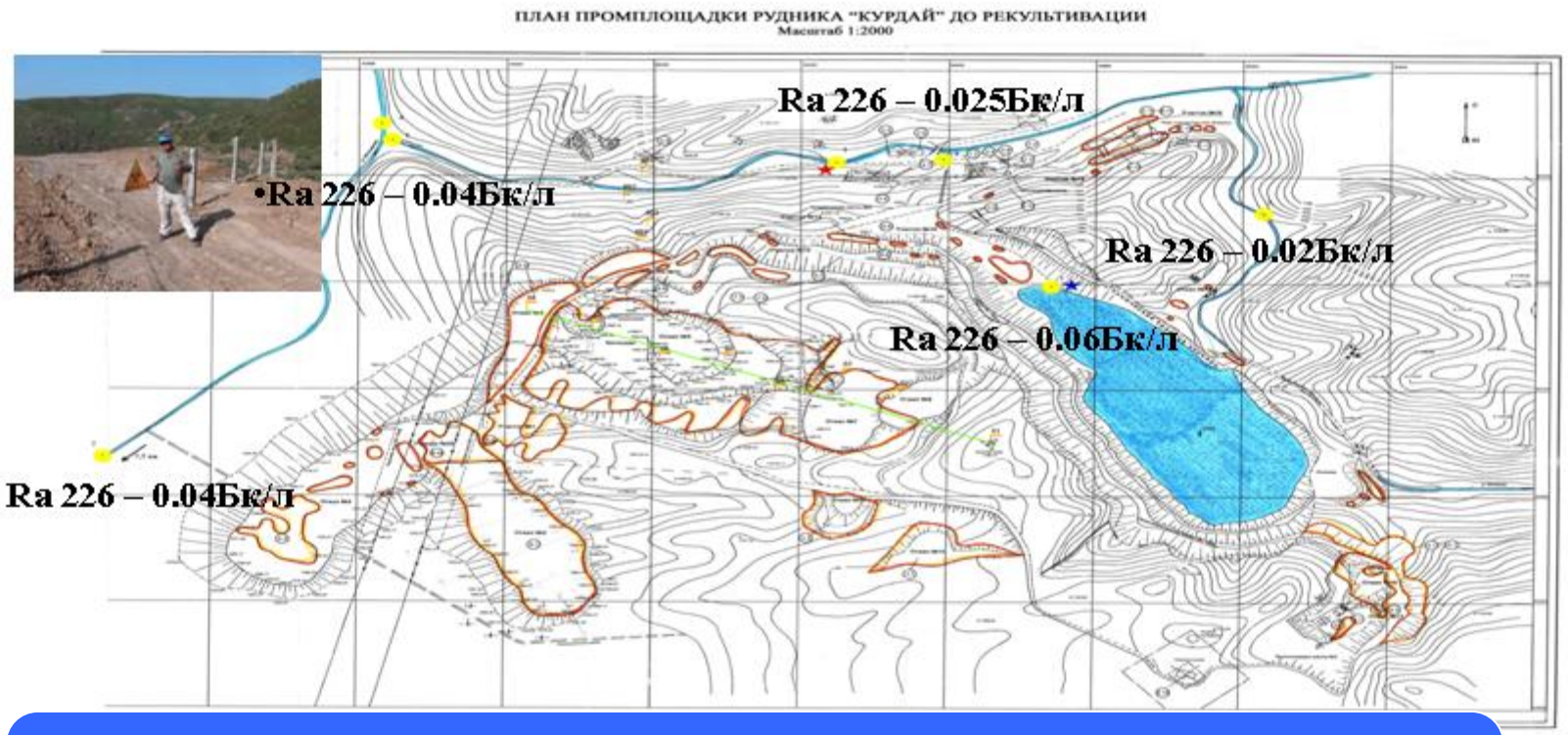
- Radioactivity of the source:
  - Absorbed dose rate measurements, corroboration with previous results
  - Radionuclides in water (surface, ground)
  - Radionuclides in soil/tailings
  - Outdoor Rn
  - Airborne radioactivity (to be done)
- Radioactivity of the environment
  - Indoor Rn & dose rate
  - Radionuclides in water (drinking, ground)
  - Foodstuff pathway
  - Airborne radioactivity (to be done)

# Samples - measurements

- Gamma dose rate, alpha track, Rn dose rates – GPS
- Analysis of radionuclides in environmental samples
- Particle analysis: 2D composition, size, structure
- Water: *In situ* fractionation, lakes, rivers, groundwater, run-off
- Fish: gills, organs, trophic levels, BCF
- Soils/sediments: sequential extractions
- Vegetation: transfer factors

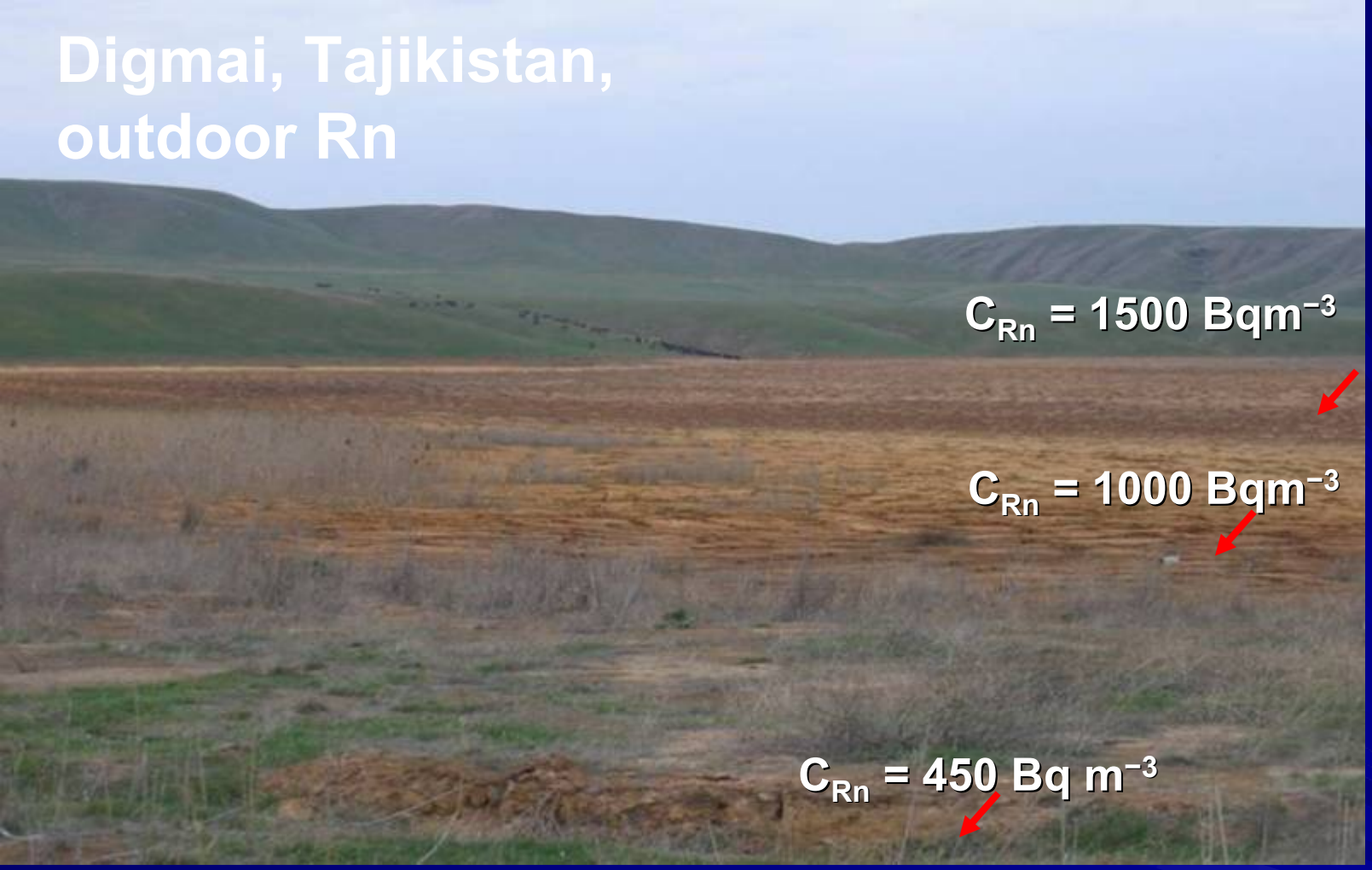
Methods: alpha-, beta-, gamma-spectrometry, INAA, RNAA, ICP-MS, ICP-OES, FIMS, IRMS, SEM, 2D synchrotron XRD, XRF

# RESULTS




Ra-226 in surface waters: field mission to Kurday, Kazakhstan, May 2006

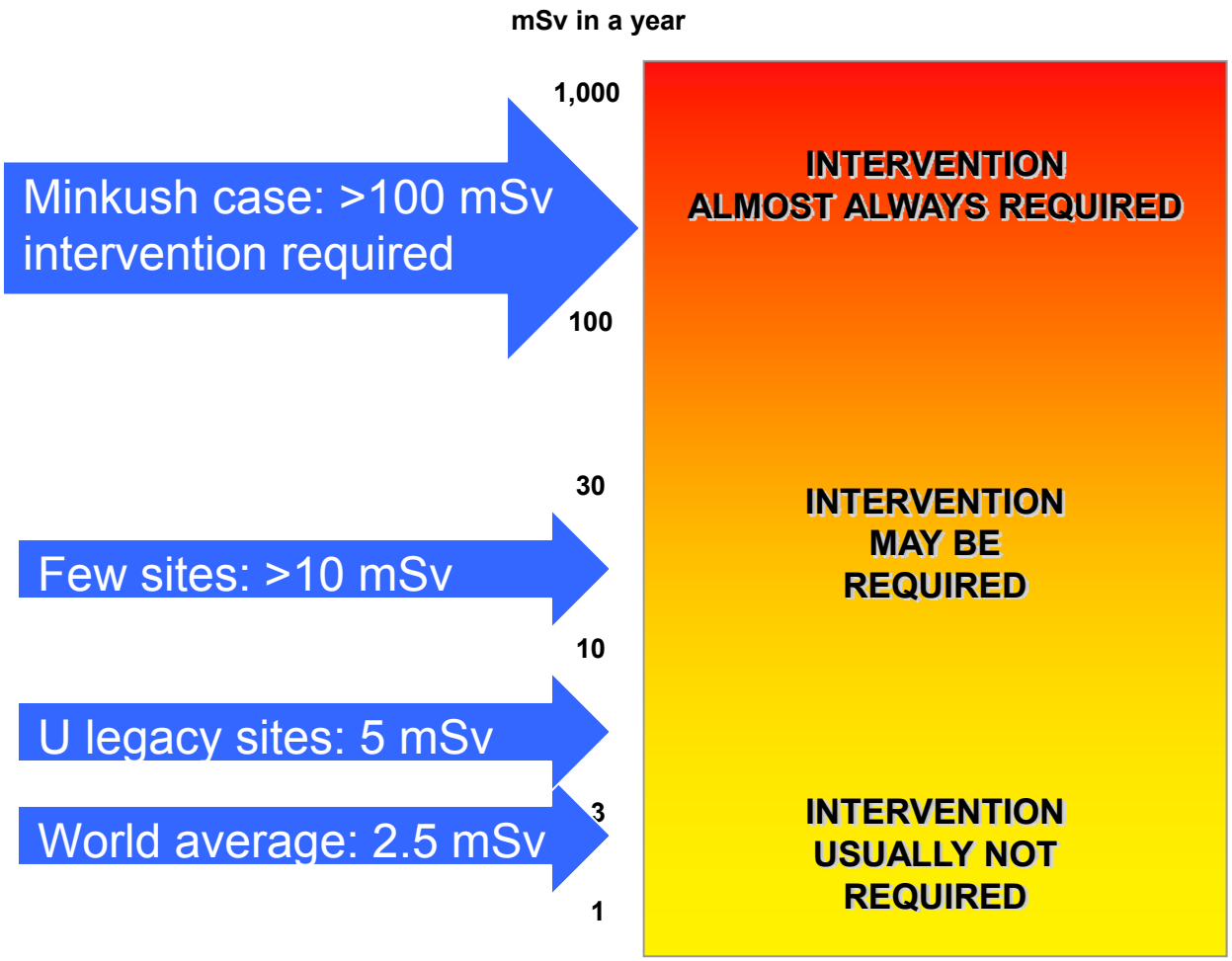
# Digmai, Tajikistan, outdoor Rn



Potential environmental impact via airborne radionuclides
Possible ground water contamination with time
Countermeasure: PREVENT access – reduce/eliminate physical hazard

Taboshar, Tajikistan
low grade ore extraction site
4 M m3 tailings

# Individual annual current doses

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# Risk assessment

Radiological risk versus non-radiological:

- Chemical contaminants
- Physical risk - geohazard

Perceived radiological risk versus actual risk:

- Perceived risk by population high, based on lacking information, low living standard, emotions – radiophobia
- Actual radiological risk: very low

# Conclusions

- Radiation doses to man relatively low, no radiological risk and no actual health impact on resident populations
- Radiation at investigated sites localised to limited areas, could potentially influence/impact downstream areas due to river and airborne transport
- Metal exposure, especially of As, is high at mining sites, and is transported downstream
- High ecosystem transfer of selected radionuclides and metals
- Multiple stressor aspect should be considered

# Future activities

- NATO RESCA Project and the Norwegian Project continue jointly with other relevant projects/programs in CA region
- Trace elements, in particular toxic heavy metals should be included in future projects
  - Airborne radioactivity
- Several new NATO SPS projects planned

# Legacy of Uranium Mining Activities in the Central Asia - Contamination, Impact and Risks

Summary Report of Results obtained within the NATO RESCA Project and the Joint Project between Norway, Kazakhstan, Kyrgyzstan andTajikistan