

TMF management and accidents in the UNECE region, including in a transboundary context



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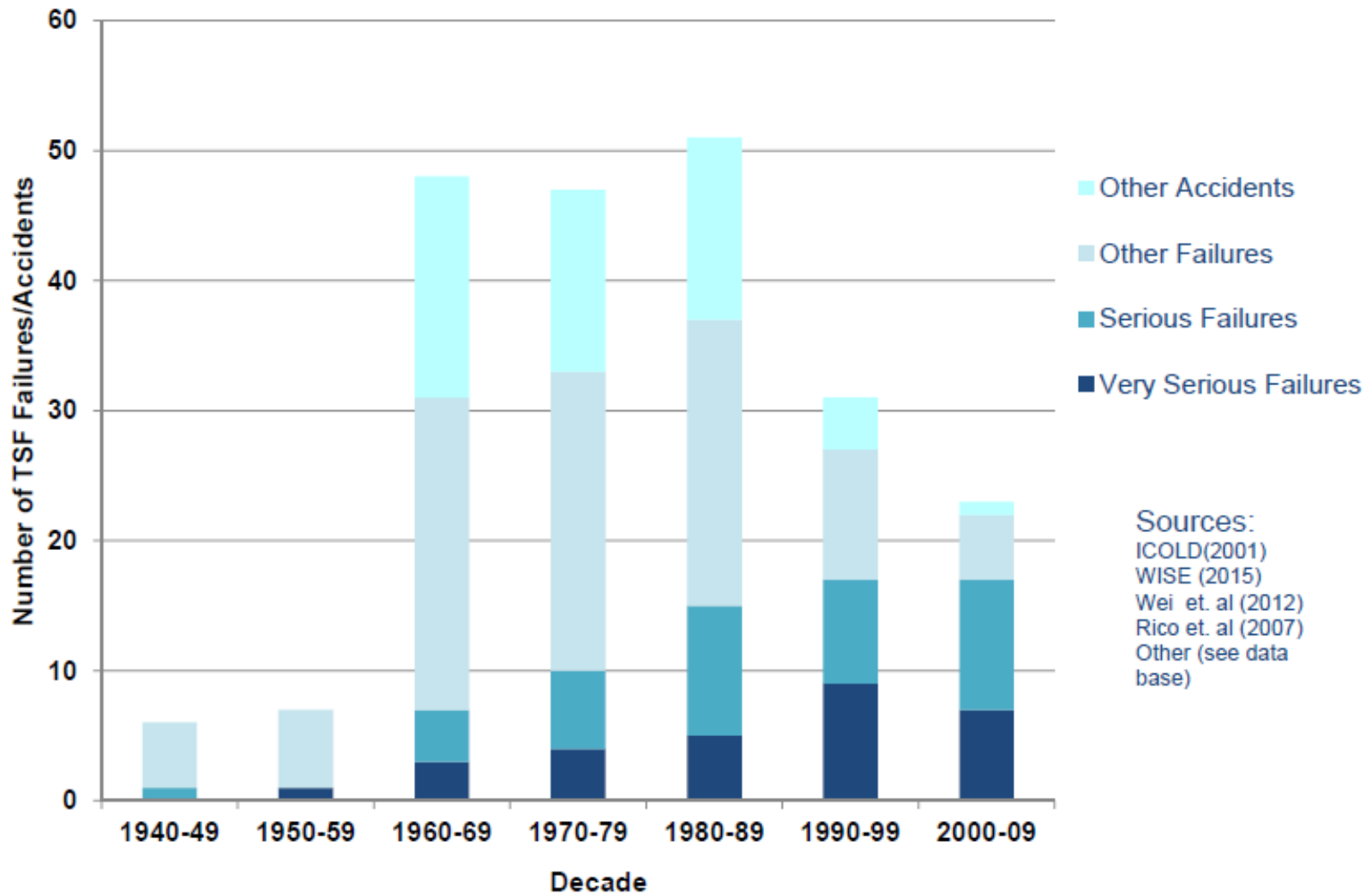
TAILINGS 2018, Astana

Motto

Satellite imagery has lead us to the realization that tailings facilities are probably the largest man-made structures on earth. Their safety, for the protection of life, the environment and property is an essential need in today's mining operations. These factors, and the relatively poor safety record revealed by the numbers of failures in tailings dams have led to an increasing awareness of the need for enhanced safety provisions in the design and operation of tailings dams. (ICOLD 2001)



History of major tailing dams accidents



Some examples and case studies

- Kolontár (Aika) 2010
- Stava 1985
- Baia Mare 2000
- Los Frailes 1998
- Atik 2000



Kolontár (Ajka), Hungary 4.10.2010: "Redsludge" tragedy



On 4 October 2010, a “red mud” spill had occurred following a tailings pond failure at an aluminum processing plant in Hungary. Red mud driven by the pond water flooded downstream 2 villages and travelled through a creek leading to the Danube River, approx. 160 km.

Source: Dr. C. Zanbak, TCMA report

Kolontár (Ajka), Hungary

after



6 October 2010

(GoogleEarth photo)

Kolontár (Ajka), Hungary



Effect of sludge



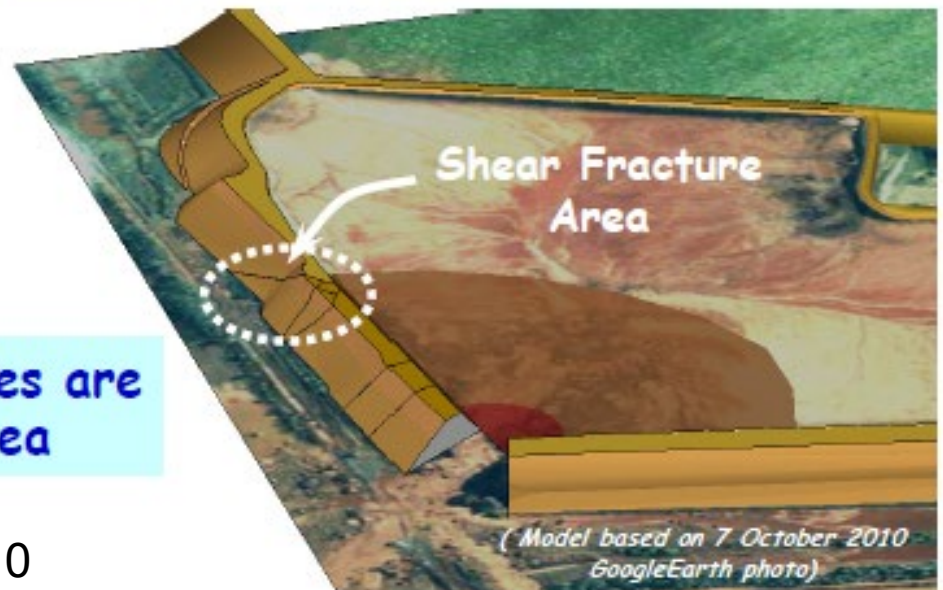
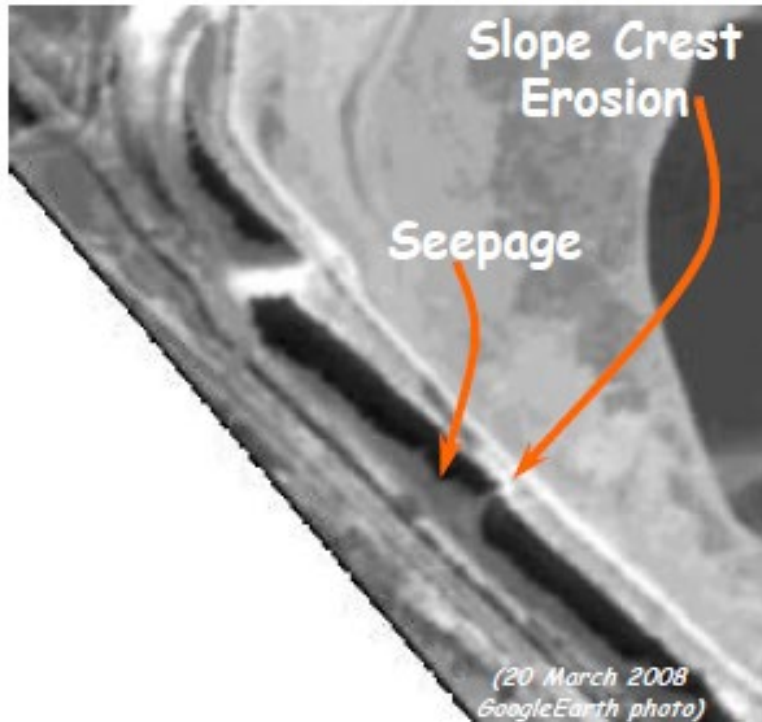
Post-Failure Aerial View of the Ajka Tailings Pond (Oct. 2010)



Apparently,
about 10% of the tailings solids were washed-out by scouring effect of the run-away water.

Please note the "vortex in the tailings" and the "diagonal fracture" on the North Dike
(for their relevance in the triggering mechanism of the failure).

EARLY WARNING SIGNS OF THE FAILURE



Post-Failure Shear Fractures are
Located at the Seepage Area

Pre-failure Seepage and Crest Erosion Marks on the North Dike of AJKA Pond

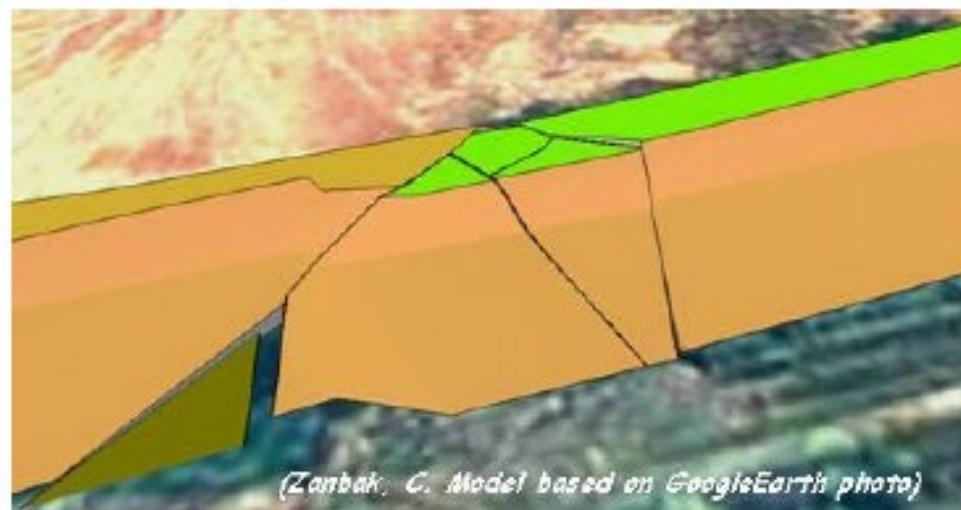
(26 June 2010)



SOURCE: Dr. Zambak report, dec. 2010

Post-failure Shear Fractures on the North Dike

(Note the vortex cone in the tailings revealing discharge through the shear fracture)



(Zambak, C. Model based on GoogleEarth photo)

Lessons learned from Ajka accident

- The information that content of the tailing is not characterized as „hazardous“ does not assure safety
- Behaviour of sludge as pH, particulates, viscosity, inertial force etc. must be evaluated as well
- Signs of coming accidents were overviewed and neglected
- Without real emergency plan, efficiency of accident mitigation may be very limited

What is needed in the case of accident ?





Case study: STAVA

On July 19, 1985, a fluorite tailings dam of Prealpi Mineraia failed at Stava, Trento, Italy. 200,000 m³ of tailings flowed 4.2 km downstream at a speed of up to 90 km/h, killing 268 people and destroying 62 buildings. The total surface area affected was 43.5 hectares.

Stava accident

- The tailings dam consisted of two basins built on a slope. The failure with a collapse of the up-slope basin. The inflow of the released material caused the overtopping and subsequent collapse of the lower basin.
- Dams were constructed with an unacceptably low factor of safety and that the failure probably was triggered by a blocked decant pipe located within the tailings.

Stava lessons learned

- Tailing location had been badly chosen in view of the vulnerability of the downstream town and hotels.
- Bad safety management

Case study:

BAIA MARE

is subject of other
presentation



January 30, 2000 in Baia Mare (Romania)
the biggest freshwater disaster in Central
and Eastern Europe.

Nearly 100,000 m³ of cyanide and heavy
metal-contaminated liquid spilled into the
Lupus stream, reaching the Szamos,
Tisza, and finally Danube rivers and killing
hundreds of tonnes of fish and poisoning
the drinking water of more than 2 million
people in Hungary.

Case study: LOS FRAILES



April 25, 1998

tailings dam failure of the Los Frailes lead-zinc mine at Aznalcóllar near Seville, Spain,

released 4-5 million cubic meters of toxic tailings slurries and liquid into nearby Río Agrio, a tributary to Río Guadiamar.

The slurry wave covered several thousand hectares of farmland, and it threatens the Doñana National Park, a UN World Heritage Area.

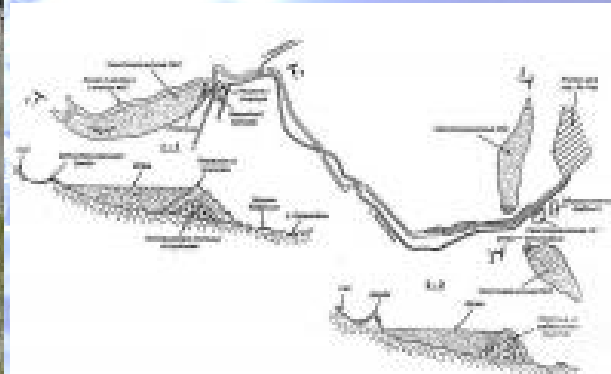


AITIK

On September 8, 2000, the tailings dam of Boliden's Aitik copper mine near Gällivare in northern Sweden failed over a length of 120 meters. This resulted in the spill of 2.5 million cubic meters of liquid into an adjacent settling pond. Boliden subsequently released 1.5 million cubic meters of water from the settling pond into the environment to secure the stability of the settling pond.



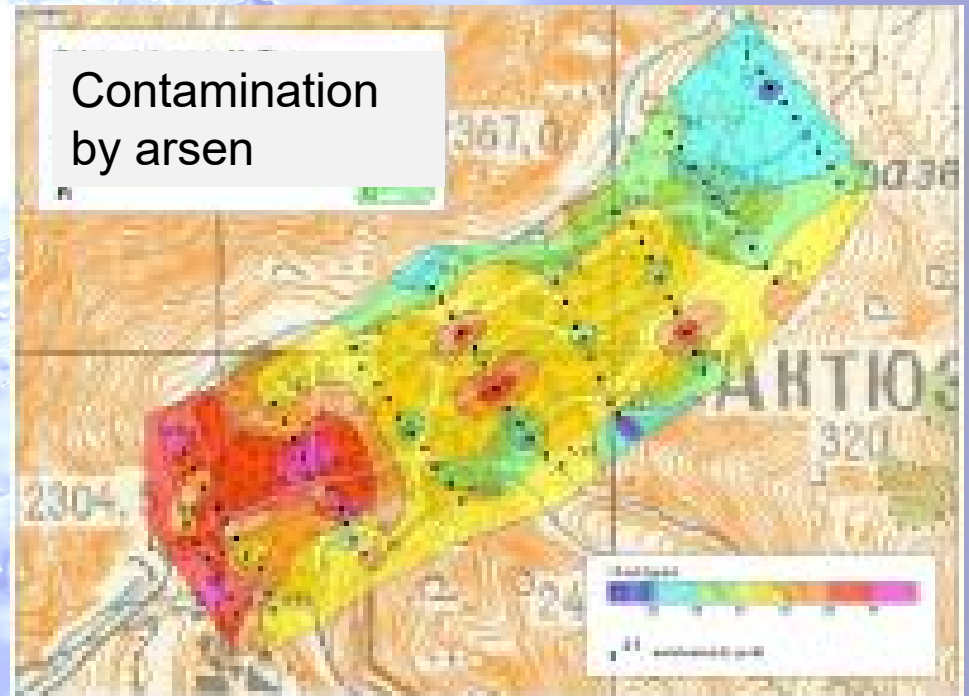
Ak-Tjuz ...not so far from here and with possible transboundary effects....



- Approx. 4,7 mil. m³ wastes with toxic metals and radioactivity

Ak-Tjuz tailing accident

- December 1964, due to the combination of earthquake, rain and bad management break and 680 000 m³ radioactive wastes leaked to the waley of Kichi-Kemin river. Flow of toxic mud 40 km.



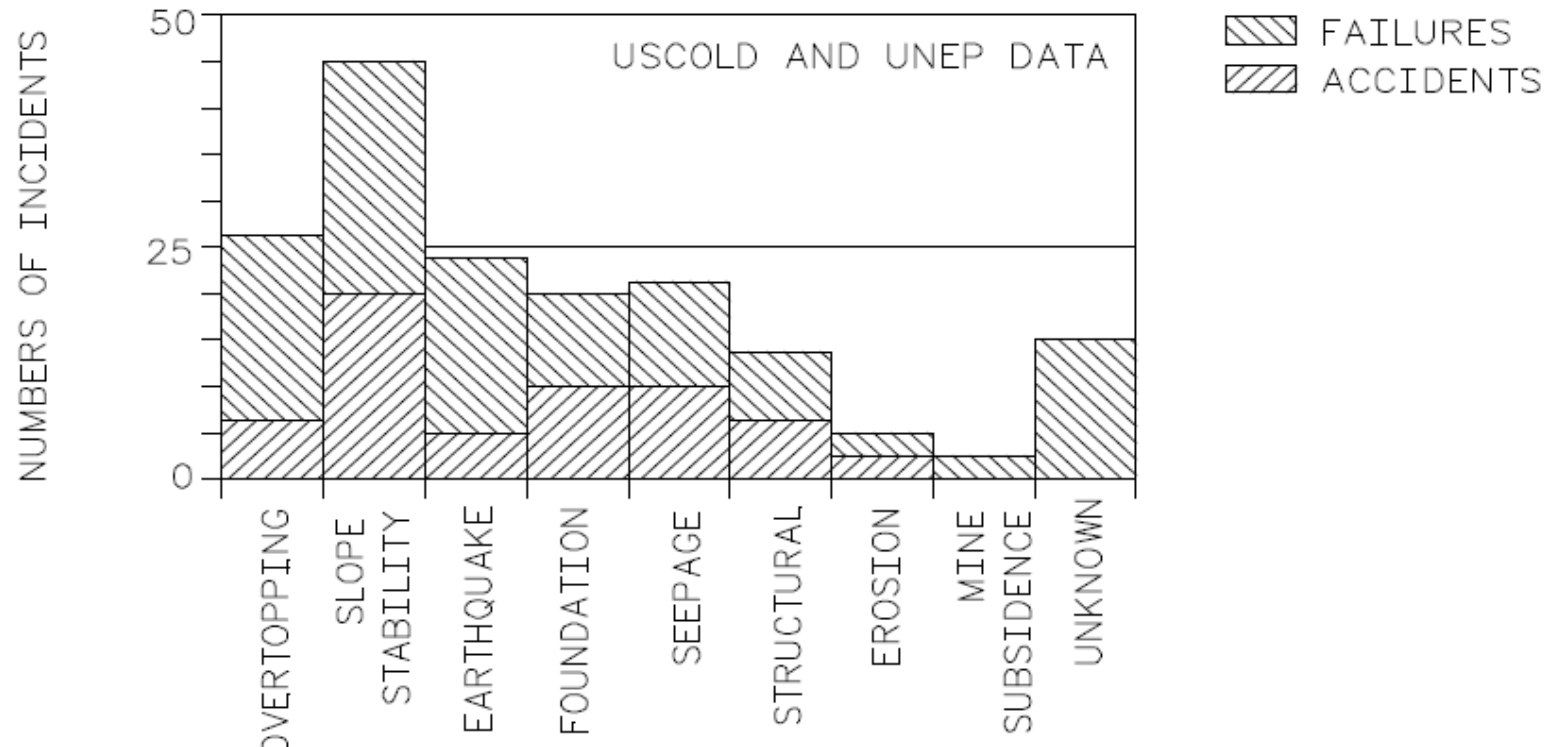
VARIABILITY OF CAUSES OF ACCIDENT

- Inadequate management
- Lack of control of hydraulical system
- Error in site selection and investigation
- Unsatisfactory foundation, lack of stability of downstream slope
- Seepage
- Overtopping
- Earthquake
- Landsliding

MAIN ROOT CAUSE:

RISK ANALYSIS AND MANAGEMENT NEGLECTED

Distribution of causes of tailing dams accidents



Tailings dam incident cause comparison with incident type for active dams.

Source: ICOLD Bulletin 121

VARIABILITY OF CONSEQUENCES

1. Flooding, wave of slurry
2. Contamination of surface water, living organisms intoxication
3. Drinking and irrigation surface water contamination
4. Drinking and irrigation underground water contamination
5. Soil contamination
6. As consequence of 2),3),4)ad.5 : Food chain contamination

» FREQUENTLY INVOLVES TRANSBOUNDARY EFFECT

CONSEQUENCES II:

- Consequences to human lives, health and well being. Evaluation of consequences with stakeholders necessary
- Direct costs (remediation, compensation, ...)
- Social disturbance
- Consequence to environment – short time and long time impacts
- Economical consequences and operability
- Indirect costs

Costs of Failure

Physical failure: recent large failures \$30 to \$100 millions in direct costs

Environmental failure: some recent clean-up liabilities to several \$100's of millions

Closure liability: some recent examples in \$ 500 million to \$ 4 billion range

Industry/investor impacts: Shareholder value losses and industry imposed constraints and costs amounting to many billions of dollars

Emergency preparedness

- Preparedness to accident, even with low probability
- Training and not only desktop one
- Information of all potentially involved
- Crisis management including training
- Open and honest communication with municipalities, emergency response teams, government bodies (inspection...)
- Communication with media



One mythus:

We will manage accident by
improvisation...















Another mythus:

„We operate it long time without any accident, so safety is prooved“



**Lassing Talk Mine,
Austria 1998**



**Aberfan, Wales (UK)
1966**

2 Feb. 2000



Thank you very much for your
attention!