

Event on nuclear in Ljubljana, Slovenia, 2.12.2013



Faire avancer la sûreté nucléaire

FOCUS's request



« *Presentation of IRSN report on possible NPP Krsko II site.*

What are the implications of this report? »

Oona Scotti

OUTLINE

- Context of the Krsko II project, the actors, the findings
 - Consortium conclusions for seismic hazard assessment and capable fault issues
- IRSN' position concerning Krsko II
- IRSN recommendations for Krsko seismic hazard assessment

■ BGIZ_Consortium Members

- BRGM (France) - GeoZS (Slovenia) - IRSN (France) - ZAG (Slovenia)

■ Subcontractors

- Drilling company (CTE SPA, Italy), Slovenian Environment Agency (Slovenia), Geostern (Slovenia), Geoexpert (Switzerland), ROVS (Slovenia), University of Ljubljani (Slovenia), Geoinženiring (Slovenia), Geoarh (Slovenia), GEOLOŠKEEKSPERTIZE (Slovenia), Flycom (Slovenia)

■ Reviewer and Advisor of GEN

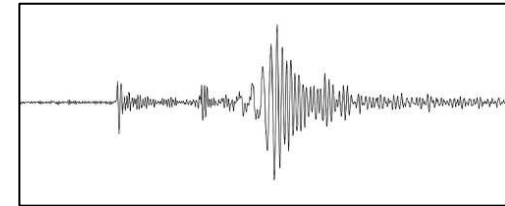
- Paul C. Rizzo Assoc., Inc.

« Krsko II feasibility study - overview »

- | Review existing reports, Carry out field investigations, Laboratory testing (for soil and rock)
- | Review Seismic Hazard Study prepared for Krško in 2004 - update if necessary, identify controlling earthquakes
- | Determine
 - SSE ground motion,
 - the potential for surface tectonic and non-tectonic deformations, and other design conditions
- | Phase 1 -- ► preliminary GG&S evaluations to determine site feasibility.
- | Phase 2 -- ► include final assessment study and final report

« Krsko II feasibility study - today's topics »

- Review of 2004 Krsko I Seismic Hazard and Update if necessary



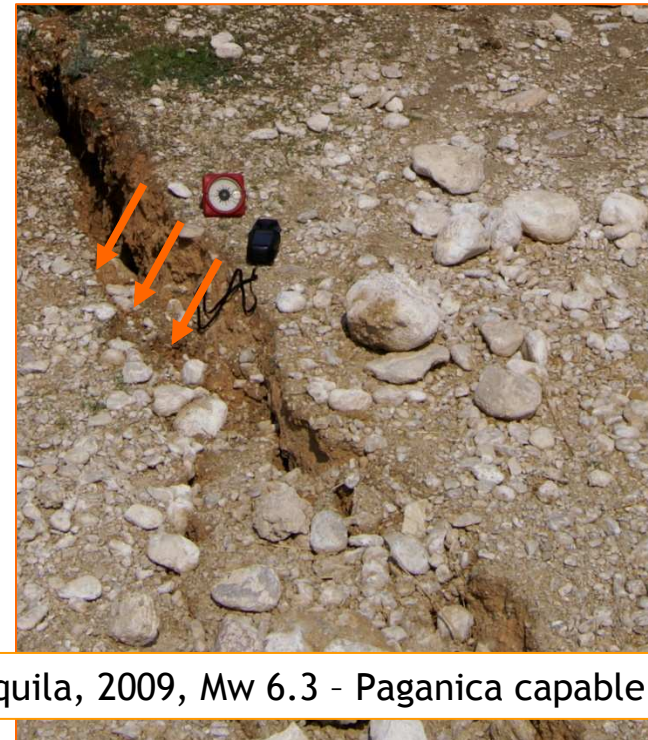
Shaking Hazard

IRSN Responsibility

- Determine the potential for surface tectonic and non-tectonic deformations

Displacement Hazard at the surface

GeoZs Responsibility



L'Aquila, 2009, Mw 6.3 - Paganica capable fault

BGIZ_Consortium's proposal for Krsko II for Shaking Hazard Study

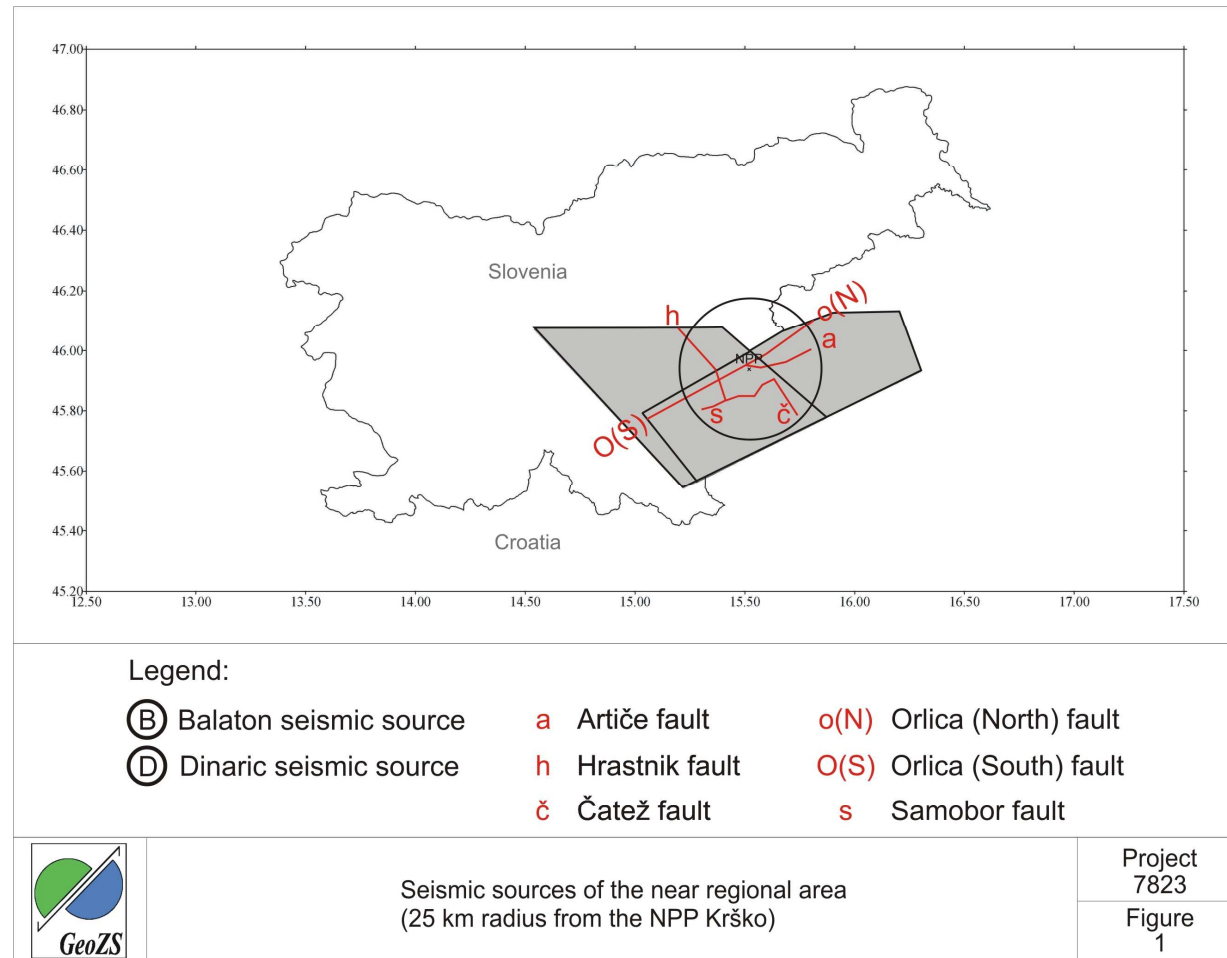
- Installation of a temporary network of seismological stations
- In-depth historical seismicity investigations
- Seismic sources characterisations (b-values, Mmax, depth)
- Updating of ground motion prediction equations (GMPE)
- **Shaking Hazard (PSHA) : review 2004 study and update**
- Shaking Hazard (DSHA) - french methodology
- Site - effects study based on DSHA

Each one of these actions was discussed and debated within the BGIZ_Consortium in dedicated Workshops

IRSN's role in Krsko II : Reviewer of 2004 Shaking Hazard Study

In the framework of 2004 EU - PHARE project, IRSN had already identified a number of issues to be tackled for future seismic hazard studies

Example of
potentially seismic sources
needing
in-depth
Investigations
(from 2004 study)



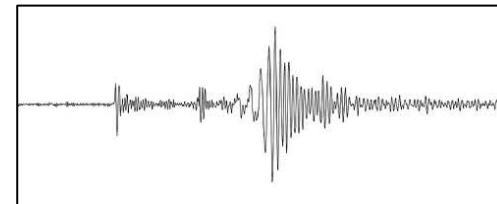
Among IRSN's 2004 recommendations

■ Need to perform field investigations of the assumed active faults

within the 5-km radius around the site :

- Precise geological investigations of Quaternary deposits
- Geomorphological studies
- Mapping
- High resolution Geophysics
- Trenching of Orlica and Artice faults

■ BGIZ_Consortium - Shaking Hazard Study



New : earthquake catalogue

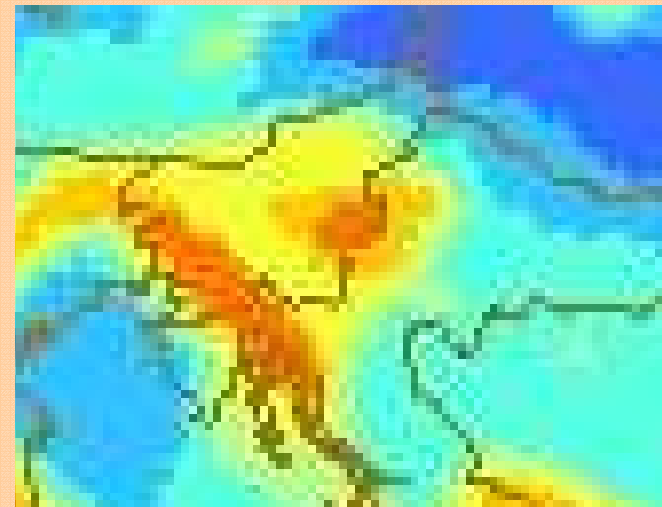
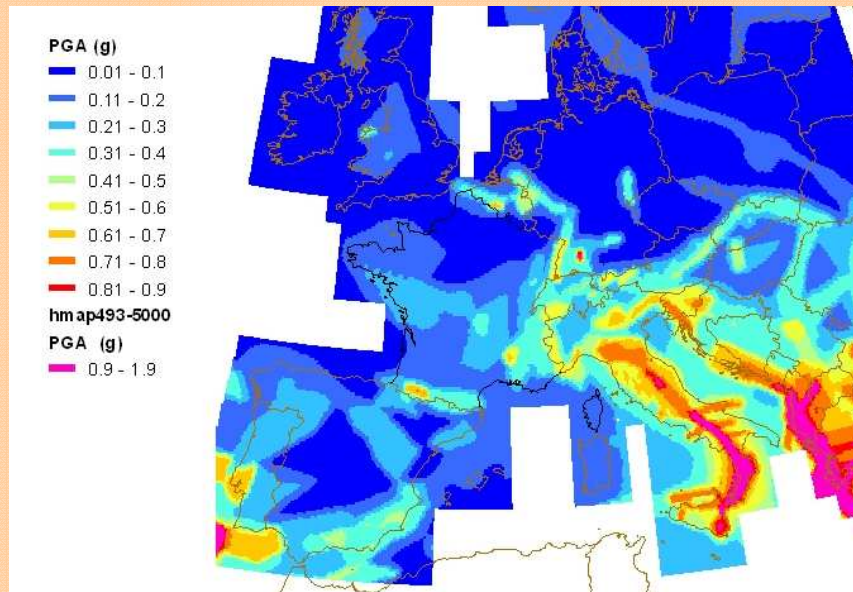
New : seismic source geometries

New : shaking equations

2009 PHASE 1 report (BGIZ_Consortium)

contains some of the preliminary updated Shaking Hazard results

2013 EU Seismic hazard confirms need for an update of the 2004 Seismic Study



(5000 years return period)

<http://www.efehr.org:8080/jetspeed/portal/HazardMaps.psml>

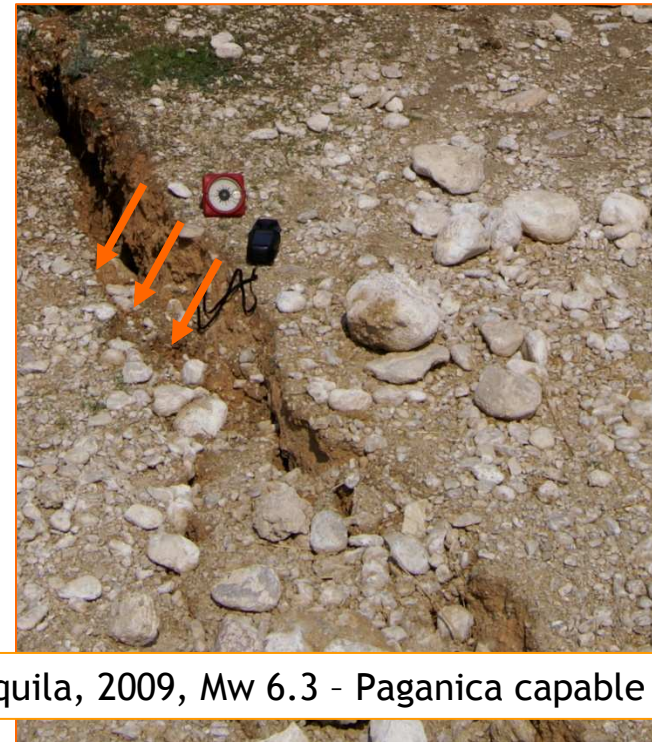
SHARE 2013 – REGIONAL Seismic Hazard study

(NOTE: A SITE SPECIFIC study evaluation may lead to different results !!!)

« Krsko II feasibility study - today's topics »

- Review of 2004 Krsko I Seismic Hazard and Update if necessary
- Determine the potential for surface tectonic and non-tectonic deformations

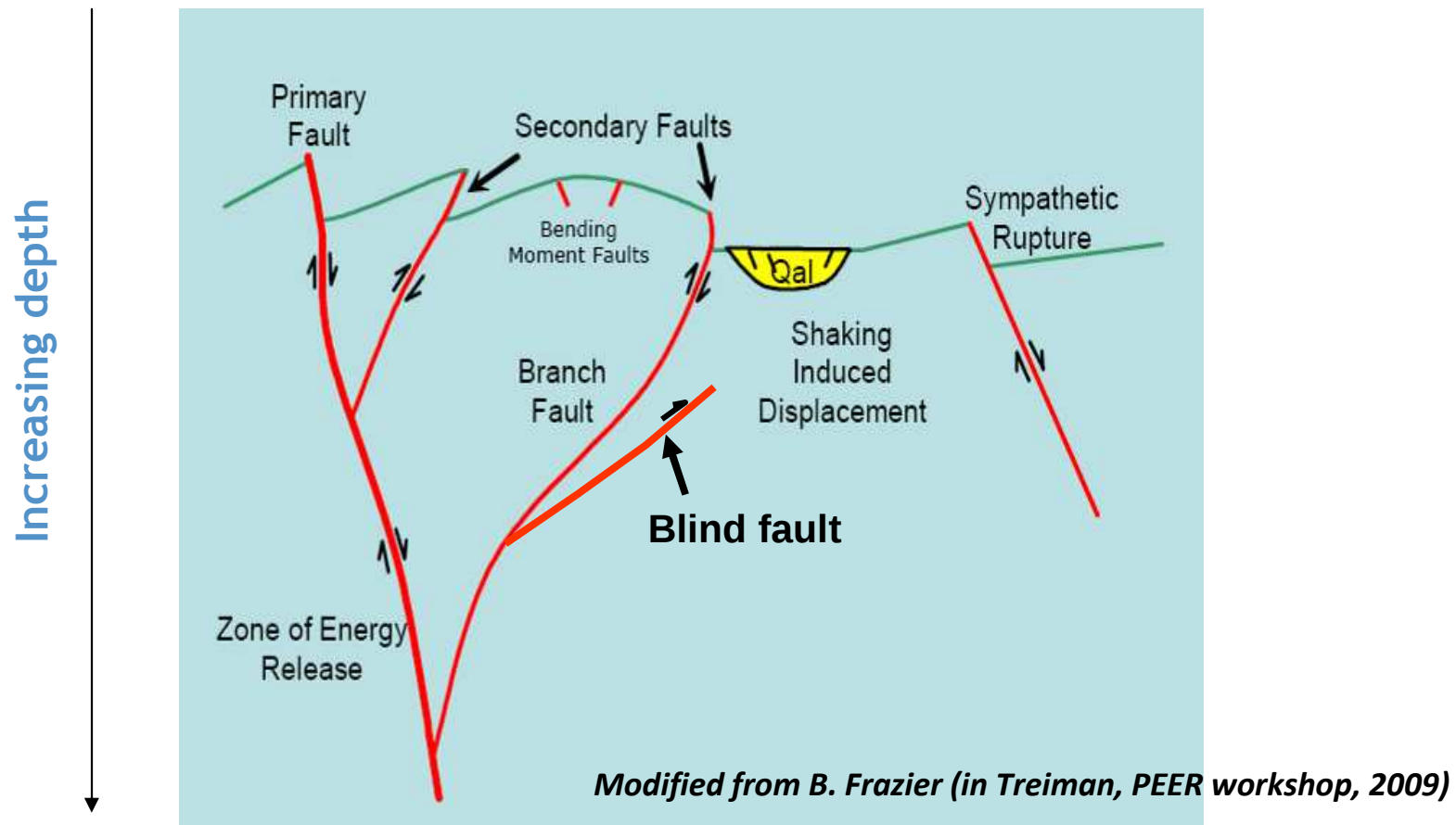
Displacement Hazard at the surface



L'Aquila, 2009, Mw 6.3 - Paganica capable fault

The capable fault issue

Vertical cross-section



Any geological structure that can induce displacement at the surface (green line)

Implications of potential displacement hazard at Krsko

Coseismic
ground rupture
following the
Aquila, 2009 |
Mw 6.3
earthquake
(mm to cm
displacements
observed in
red regions)

Boncio et al., BSSA 2012

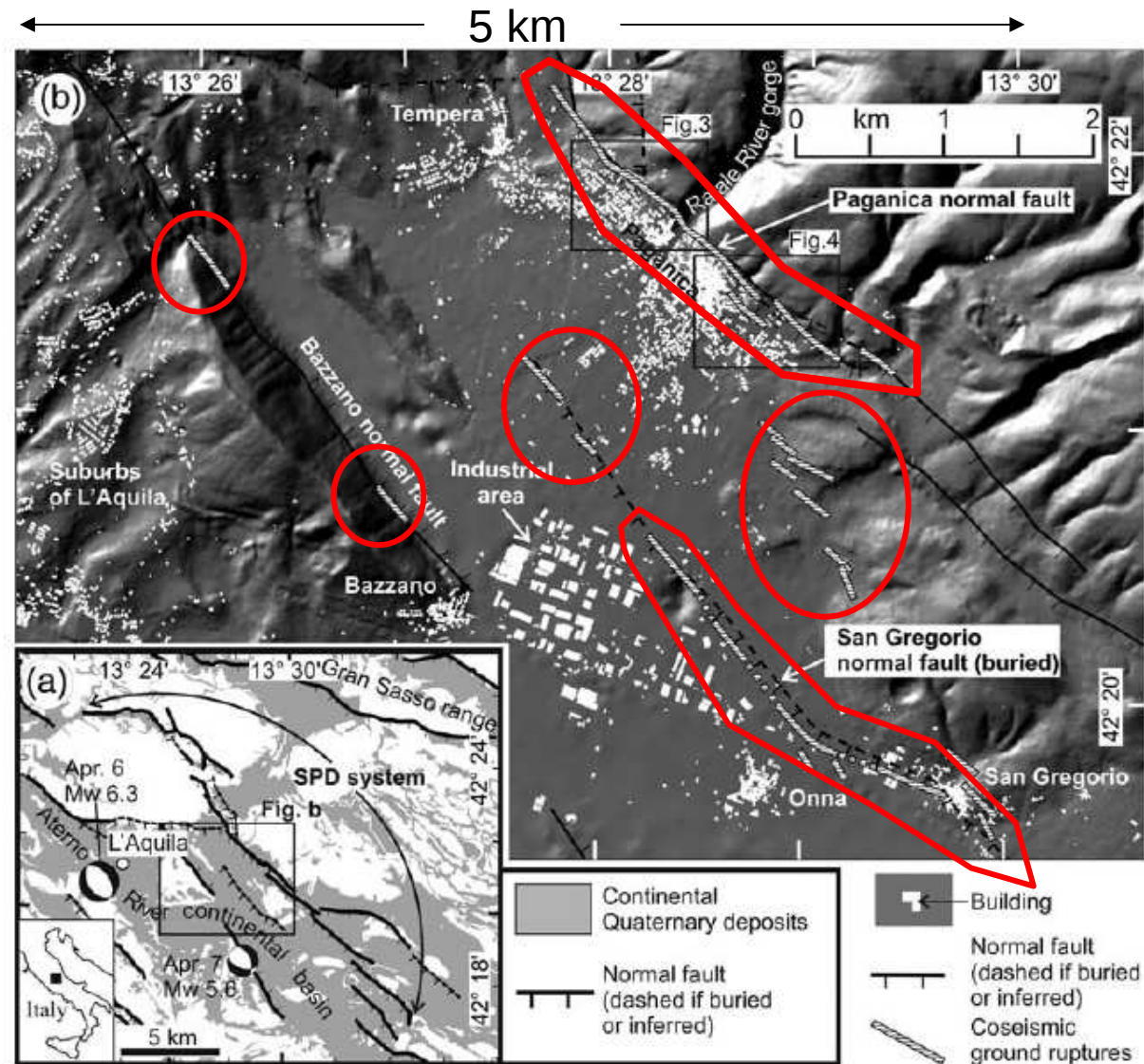
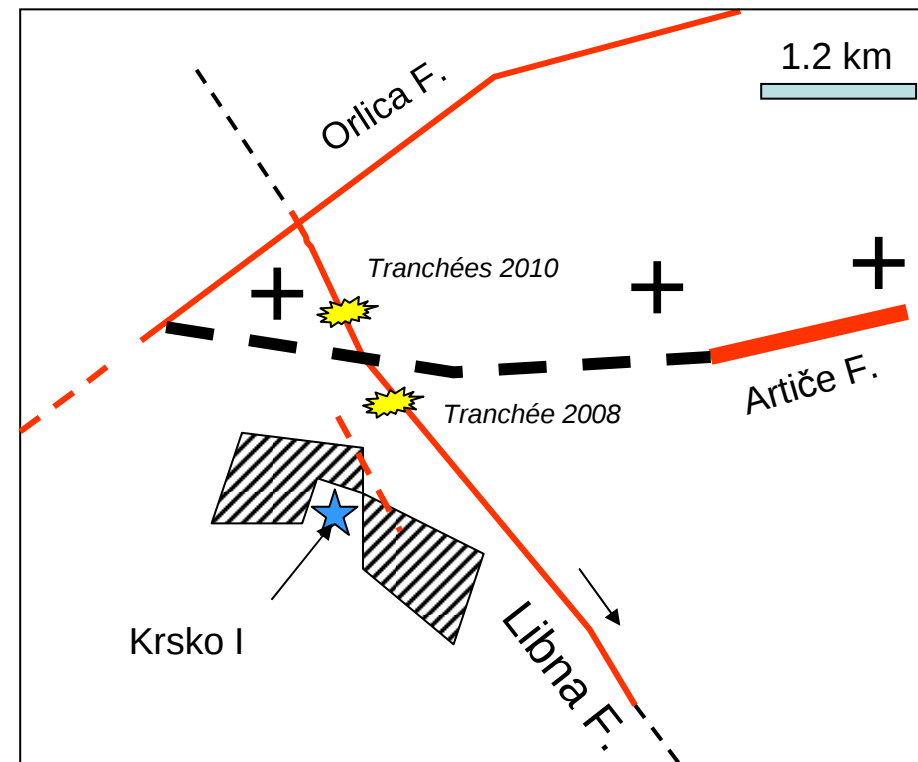


Figure 1. (a) Map of the 2009 L'Aquila earthquake epicentral area with traces of the SPD normal fault system. (b) Five-meter-resolution digital elevation model of the Paganica–San Gregorio populated areas showing the locations of active faults and traces of the 2009 coseismic ground ruptures.

■ BGIZ_Consortium investigations

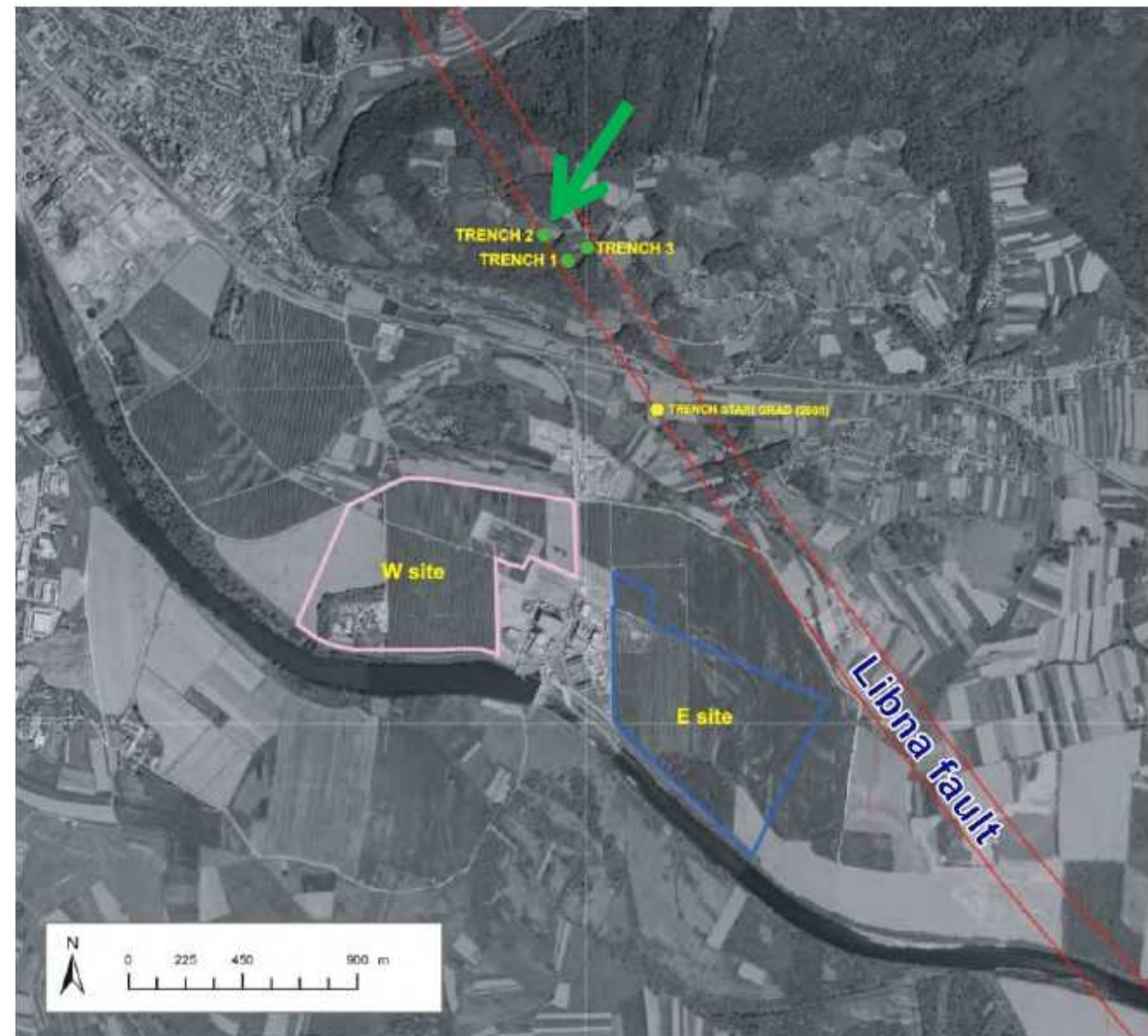
- In a 5-km radius area around the sites:
 - Geomorphology
 - Mapping
 - Geophysics
 - Trenching

- Article & Orlica structures are suspected to be the most significant faults
- At GEN's request, the BGIZ_Consortium focused field investigations on the Libna fault, the fault closest to Krsko sites

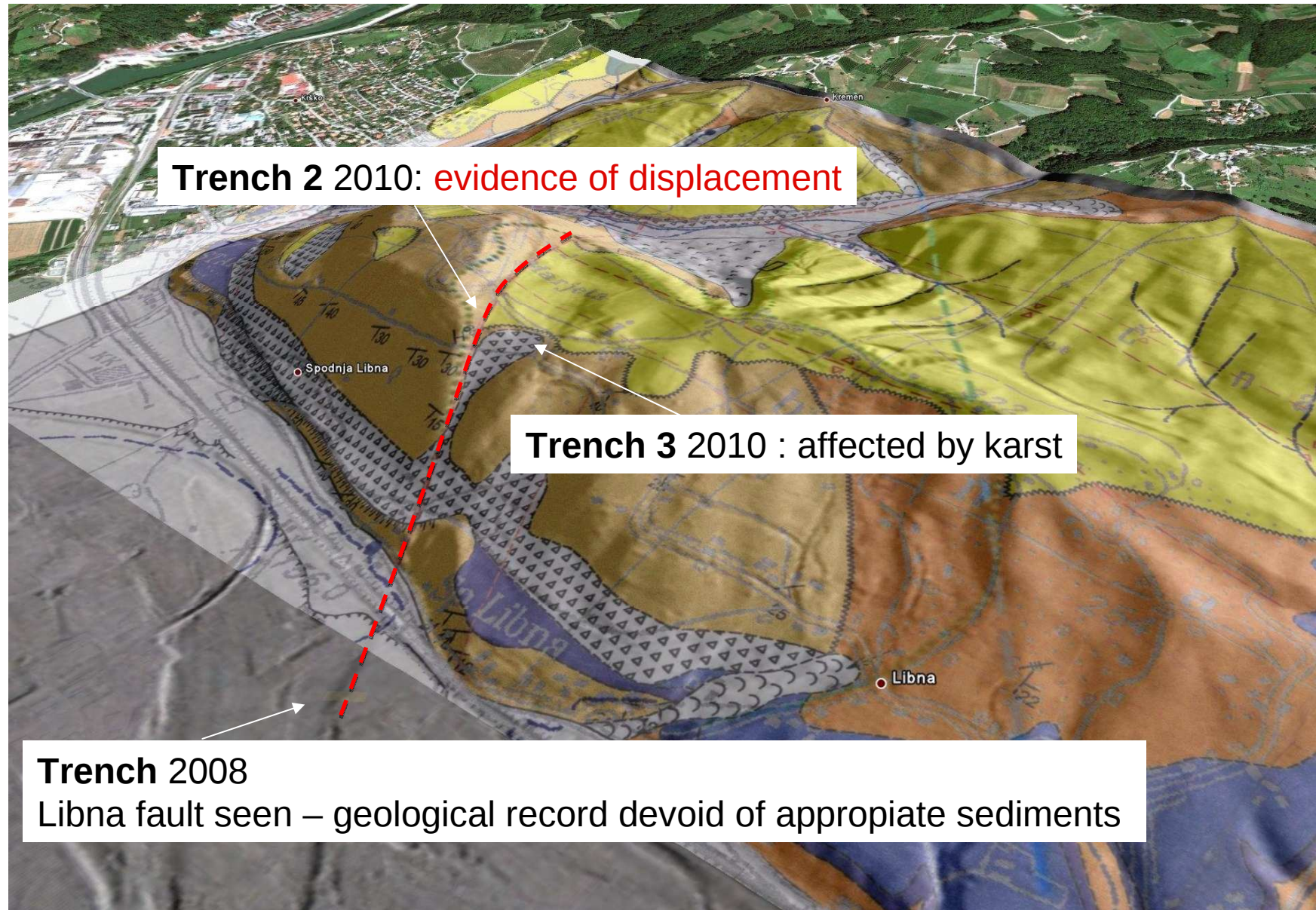


Libna Hill

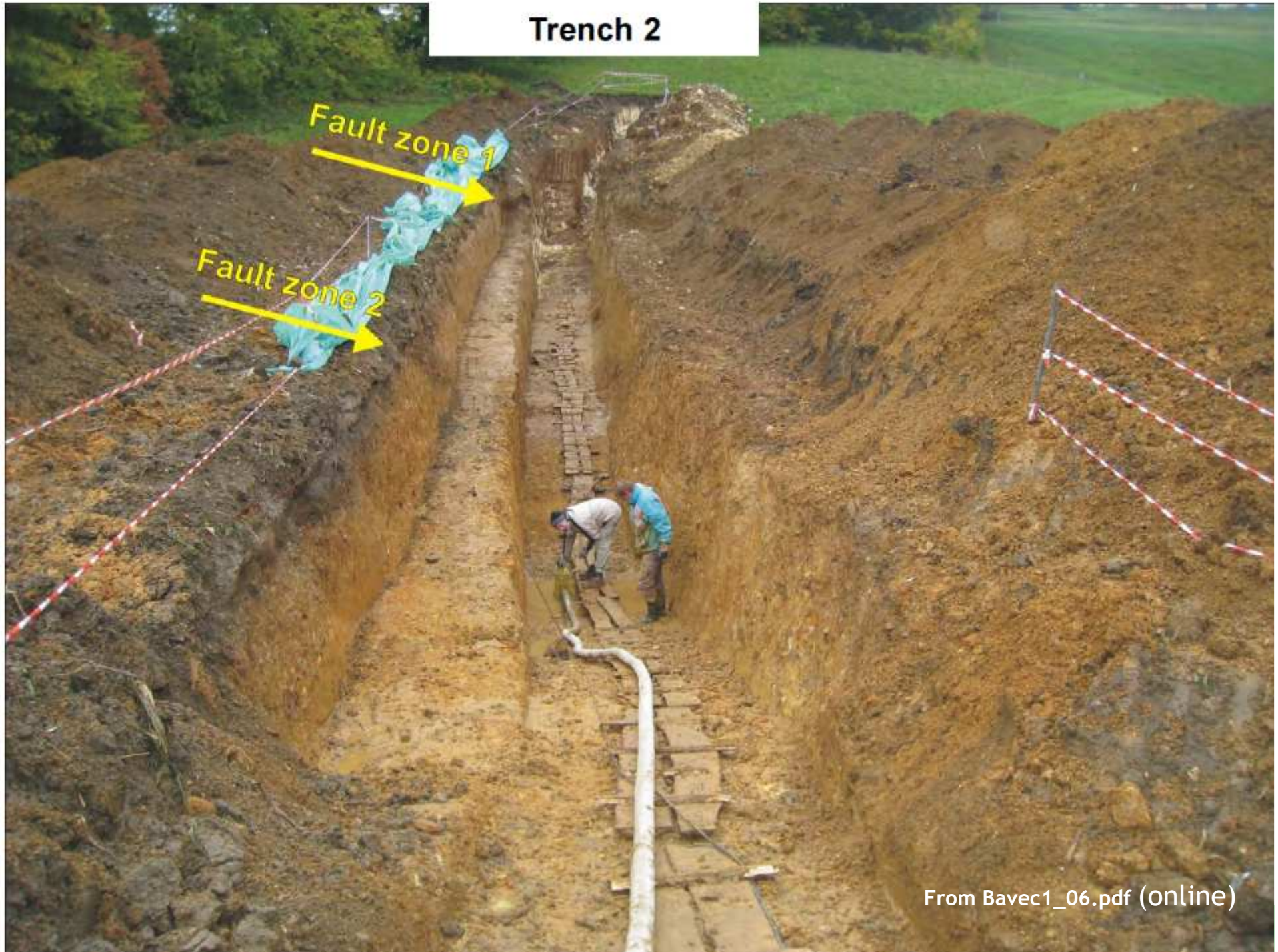
- GeoZs was responsible for the field investigations concerning the capable fault issue
- IRSN collaborated



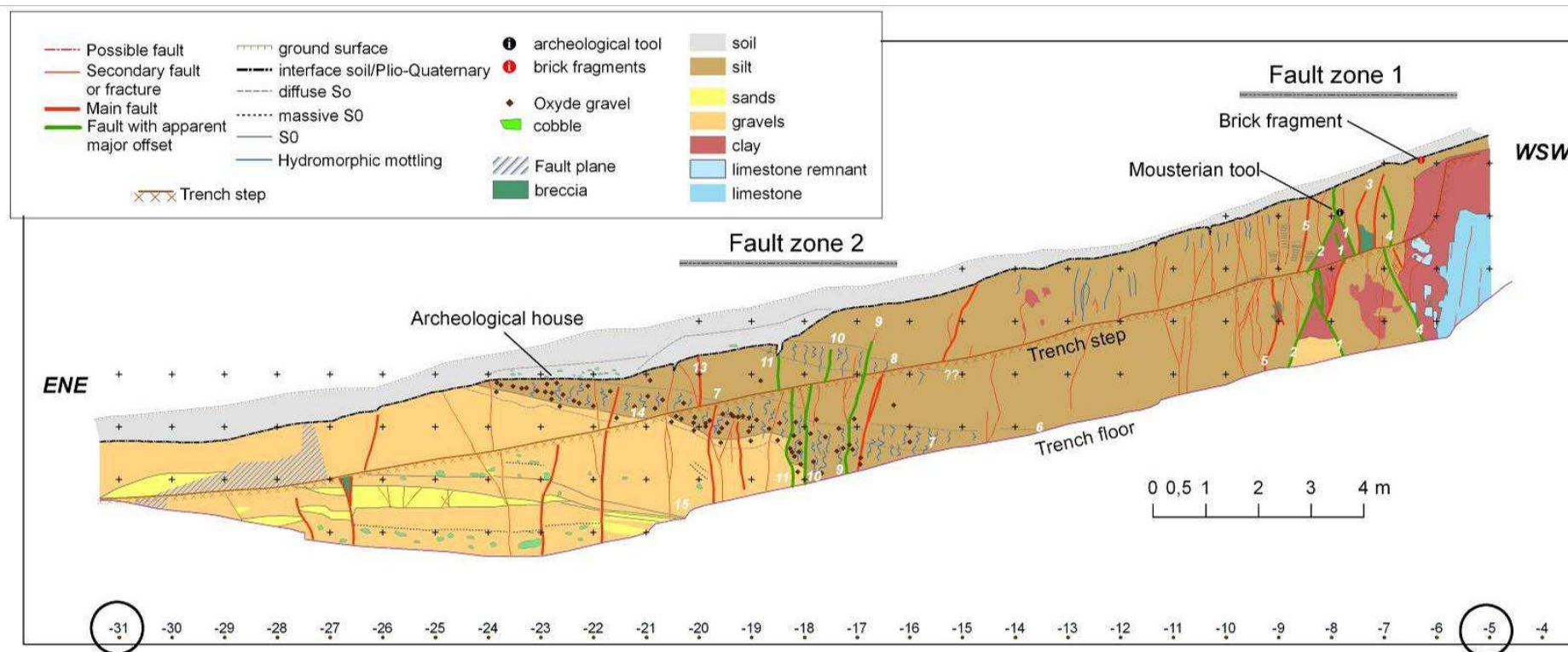
From Bavec1_06.pdf (online)



Trench 2



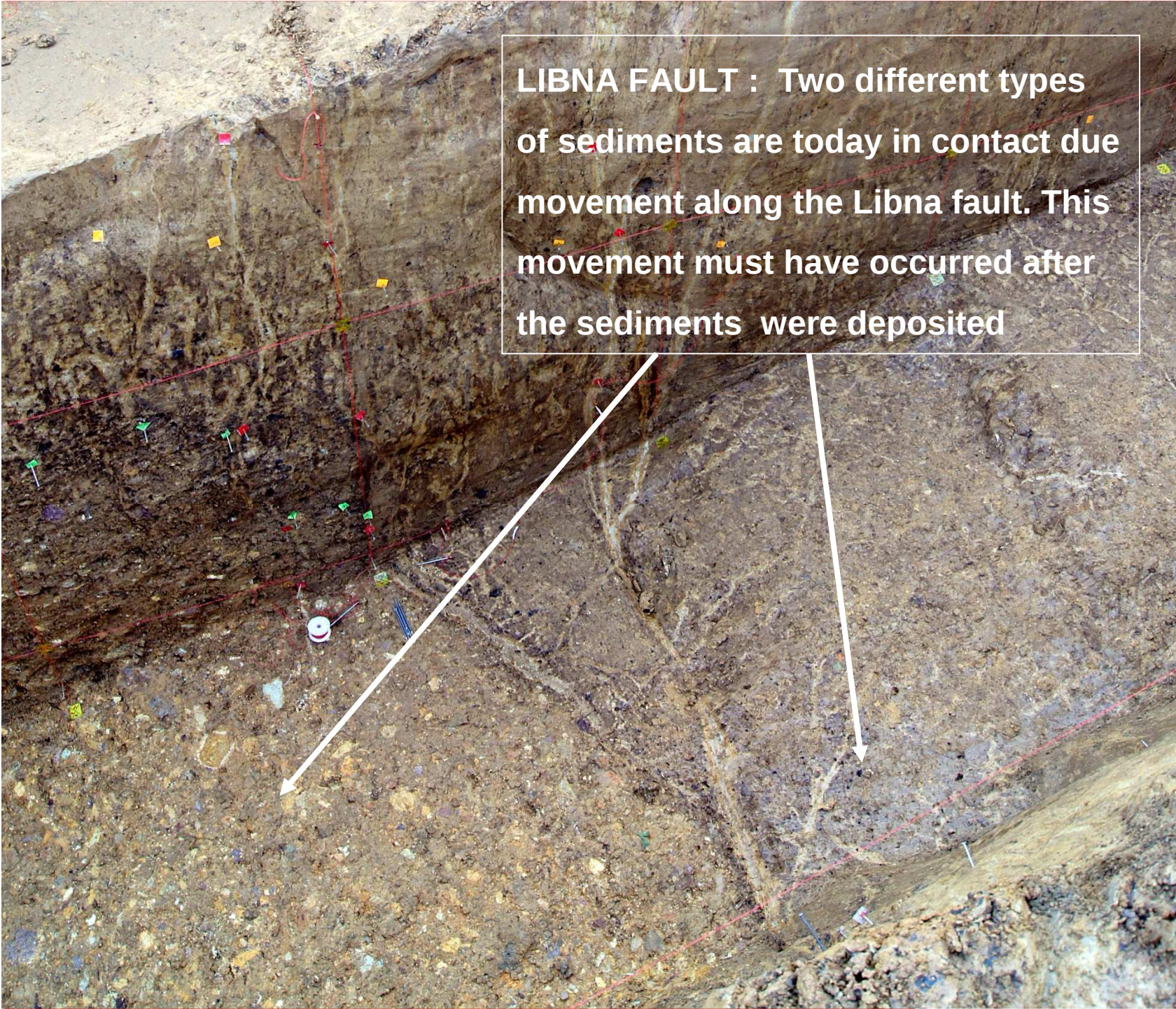
From Bavec1_06.pdf (online)



Fault Zone 2

Fault Zone 1

[Scotti_Baize_07.pdf \(online\)](#)



LIBNA FAULT : Two different types of sediments are today in contact due movement along the Libna fault. This movement must have occurred after the sediments were deposited

Age of sediments displaced by the Libna fault

between 0.1 and 0.2 Ma

(PlioQuaternary - PlQ)

Absolute age dating method (ESR, OSL)

■ At GEN's request, the BGIZ_Consortium was asked to conclude on site suitability following the Libna fault findings

- IRSN (scientific) position is the result of
- BGIZ_Consortium workshops during 4 years
 - 2 trenching campaigns
 - 1 report signed by each partner



(online)

5 CONCLUSIONS

The investigations performed by the consortium on the Libna fault, located near the two potential NPP II sites, show :

- The geologic buildup of the Libna hill is affected by strike-slip faulting, including deformation of the Globoko Pl,Q gravels and the overlying silts. Deformation is significant.
- In lack of more constraining age - dates and other geologic information, the Libna fault should be considered capable if capability is defined in line with Safety guide SSG-9 (IAEA, 2010; that defines the recent activity of the fault by investigating its past activity as far back as to Pliocene and does not condition capability with seismic potential of the fault.) **<2 My**
- The structural pattern observed in the PlQ sediments may also be indicative of coseismic and recurrent displacements.

Results were not conclusive regarding *two topics*:

- The data does not allow distinguishing between the two alternative interpretations of the observed features in the trenches: the aseismic and the coseismic one.
- Comparison of various age dates of the Plio-Quaternary sediments in the area gives inconsistent results, which sheds doubts about the age of displacement along the Libna fault.

[p3.pdf](#) (online)

Concerning the assessment of the potential impact of the Libna fault to the two potential sites of concern the consortium has not found agreement on the consequences of the findings.

→ IRSN sent its own assessment of the impact of the findings to GEN

Additional investigations and analysis proposed in this report may lead to a better assessment of the potential of displacement along the Libna fault.

■ Additional investigations on Libna fault

- Interpretation of displacement observed in trench 2
- Geophysical preliminaries for additional trench on Libna fault
- Trench on the Libna fault at the foothills of Libna Hill
- Morphotectonic study of possible continuation of Libna fault accross the Orlica Fault
- HRS survey on potential southern continuation of the Libna fault

■ Additional investigations on Artice fault

- Near-surface expression of the fault, with HRS lines and trenches

All of these actions were proposed to GEN in Jan 2011

GEN indicated to IRSN that they have implemented such activities within a new Consortium

IRSN is no longer involved in the investigations since the Libna fault findings

IRSN

INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE



Fontenay-aux-Roses, January 9th, 2013

Director General

IRSN/DIR/2013-00010

Proj. to date: 24-01-2013		
Številka	S. zbir	Način pregleda
326	DIR	N

G. J. J. J.
us T. Fojer

Objet : Contract "GG&S NPP KRŠKO II"

Mr. Martin NOVŠAK

Director-General

GEN energija, d.o.o.

Cesta 4. julija 42, 8270 Krško.

Slovenija

(online)

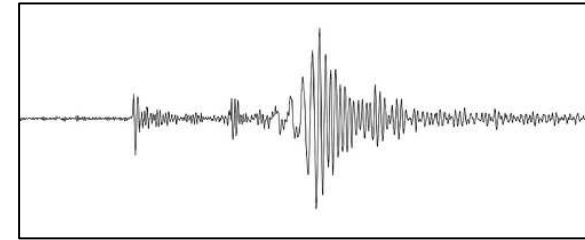
IRSN's opinion on this matter is that this new and serious finding does not allow concluding in a favorable manner as regards the suitability of the Krško II sites for the implantation of a new nuclear power plant. Acknowledging the fact that the feasibility of designing a reactor against fault surface displacement is questionable, and consistent with IAEA and NRC recommendations, IRSN believes that GEN should consider revising its strategy for the Krško II project and further examine the possibility to search for an alternative site.

GEN should examine the possibility to search for an alternative site

Should GEN nevertheless decide to pursue investigations on the Krško II sites, possibly making use of probabilistic fault displacement hazard analysis (PFDHA) for assessing site suitability, it should be recalled that the evaluation of permanent ground displacement phenomena is a highly challenging issue given the poor international experience currently available and the lack of recognized methods and tools. There is therefore in our view a major risk that this strategy fails in the end at demonstrating that the new power plant will meet current national and international safety standards. Thus, IRSN considers that the use of PFDHA is more appropriate in the process of upgrading safety demonstration of existing nuclear facilities than for supporting the licensing of new plants.

IRSN considers that PFDHA is more appropriate in the upgrading process of existing NPP

2004 Seismic Hazard study needs updating



Shaking Hazard

- Surface tectonic displacement investigations should be pursued along all potentially capable faults in the 5 km radius around Krsko (and more if necessary) to capture those earthquakes that may have ruptured to the surface in the past

Displacement Hazard at the surface

20 cm displacement



Fig. 7. Photos in the damaged area around Al Hoceima taken in March 2004.

IRSN Letter to Slovenian Nuclear Safety Authority (9th August 2013) concerning the online minutes of the SNSA April 2013 meeting

- *IRSN does agree that **PFDHA method is acceptable** for assessing the risk of displacement at the location of the **[existing]** plant **if it is supported by sufficient data, especially issued from local investigations.***
- *IRSN recognizes that the **results obtained by P. Rizzo are reassuring with regard to the safety of the [existing] plant.** IRSN is however not in a position to validate or invalidate these results since its experts have not been involved in the PFDHA study nor had the mandate or opportunity of reviewing it.*
- *IRSN confirms that, according to the preliminary studies carried out within the framework of the Krško 2 project, **the question of updating the 2004 model is raised and should be investigated further.***

Final remarks concerning Krsko Seismic Hazard and IRSN's position (2)

- .. initiate a “SSHAC level 3” process that has proved useful for conciliating the various expert opinions on seismic hazard assessment

Examples: USA (Diablo Canyon), Japan, Switzerland, South Africa etc..

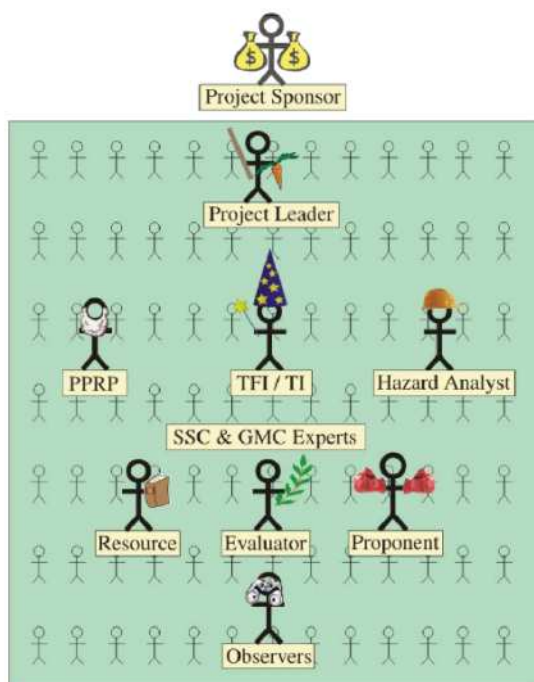


Figure 1. SSHAC participants.

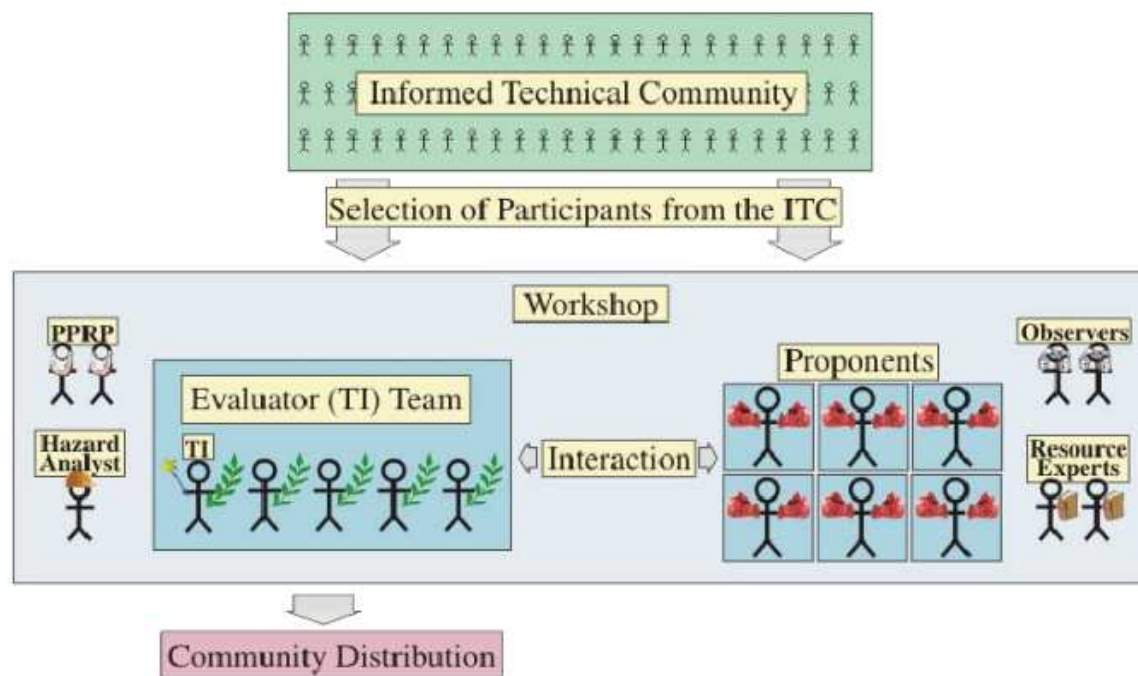


Figure 4. Expert interaction for SSHAC Level 3.

<http://pubs.usgs.gov/of/2009/1093/>

Item for Round Table discussion on Transparency Issues

■ Thank for your attention