CIRCULATIA APEI IN LOESS.

ZONA NESATURATA A LOESS-ULUI

SUBZONA USCATA

CU MODIFICARI MINIME DE UMIDITATE NATURALA

BARIERA NATURALA

IN CAZUL INGLOBARII UNUI DEPOZIT DE DESEURI RADIOACTIVE SI

ESTIMAREA PERFORMANTEI ACESTEIA

CRITERIU DE SELECTIE IN ALEGEREA UNUI AMPLASAMENT PENTRU DESEURI RADIOACTIVE

-performanta barierei naturale-zona nesaturata ce include subzone uscata a fost estimata cu modelari specific folosind date din domenii diferite:

- **geologie(hidrogeologie)-formatiunea gazda a unei constructii speciale,**
- **fizica nucleara-deseuri radioactive depozitate in constructia speciala,**
- **arheologie –analogii reprezentate de constructii milenare(similara duratei de dezintegrare totale a radionuclizilor) conservate ad-integrum,realizate in aceeasi formatiune geologica**

Baza acestei prezentari o reprezinta articolul “Efectul apelor subterane din formaţiunile loessoide asupra amplasării unui depozit de suprafaţă în zona Saligny”.Autori Durdun Ion,Nicolae Rodica.Hidrotehnica 2014

Ca formatiune gazda a unei constructii, **loess-ul** prezinta un risc geotehnic datorat sensibilitatii la umezire. În cazul infiltrarii apei in interiorul masivului,fenomen favorizat de executia si exploatarea constructiei (nu în stare naturală nederanjată), tasarea suplimentară, creşte relativ brusc, căpătând caracter de prăbuşire (colaps) atun sunt supuse si vibraţiilor seismice. Dezavantajul poate fi inlaturat prin masuri ingineresti.

Pentru realizarea unui depozit de suprafaţă pentru deşeuri acest dezavantaj se compenseaza prin:

-prezenţa unei *zone nesaturate* relativ extinse,specifica loess-ului ce include o *zona uscata* cu modificări minime ale stării de umiditate naturala, dealungul unor intervale de timp care par a fi de ordinul miilor de ani.

Apa fiind purtatorul contaminantului,posibilitatile de migrare a contaminantului sunt minime.

Prezenta acestei zone este argumentata atat direct prin date experimentale cat si indirect prin observatii asupra unor constructii in loess, vechi de peste doua milenii.

Realizarea depozitului in interiorul acestei ***bariere naturale*** in completarea barierelor ingineresti specific constituie premiza esentiala a reducerii contaminarii radioactive.

Conceptul de bariere multiple aplicat depozitului include barierele ingineresti:
1.wastes packages(conteinerele depozitate) ,
2.structure(celulele depozitului) si
naturale
3.**natural barrier(bariera naturala-formatiunea geologica gazda)**

Performantele pimelor doua bariere ingineresti vor scadea inevitabil in timp.Dupa trecerea a cateva sute de ani ele isi vor perde capacitatea de retentie,in timp ce

bariera naturala ramane.

In plus,proiectate in acord si executate correct,poate reduce mult costul total al constructiei.

•Durdun I., Mărunţeanu C., Andrei V., The adaptation of natural (geological) barriers for radioactive LILW near surface disposal in Romania. WM'01 Conference, February 25-March 1, 2001, Tucson, AZ

Bariera naturala-zona nesaturata a masivului loessoid ce include zona uscata.

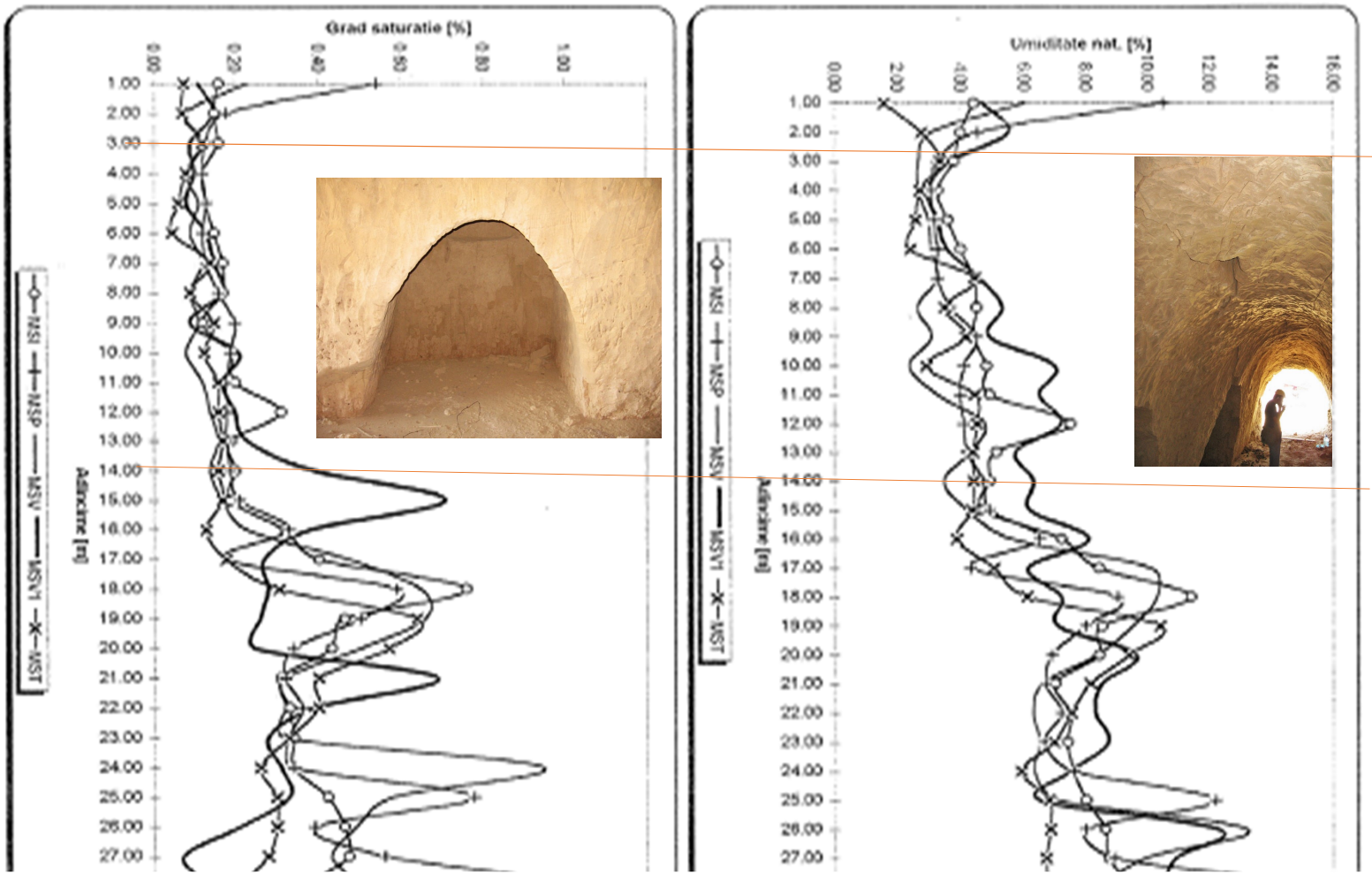
Interiorul zonei uscate
Galerii folosite ca dinamitiera la excavatile canalului Dunare – Mare Neagra,
sapate in 1938.
foto -2008

Prezenta zonei uscate cu variatii minime ale umiditatii natural se argumenteaza :

1. Direct-date din determinari de laborator pe probe recoltate din foraje sau galerii sapate in loess.

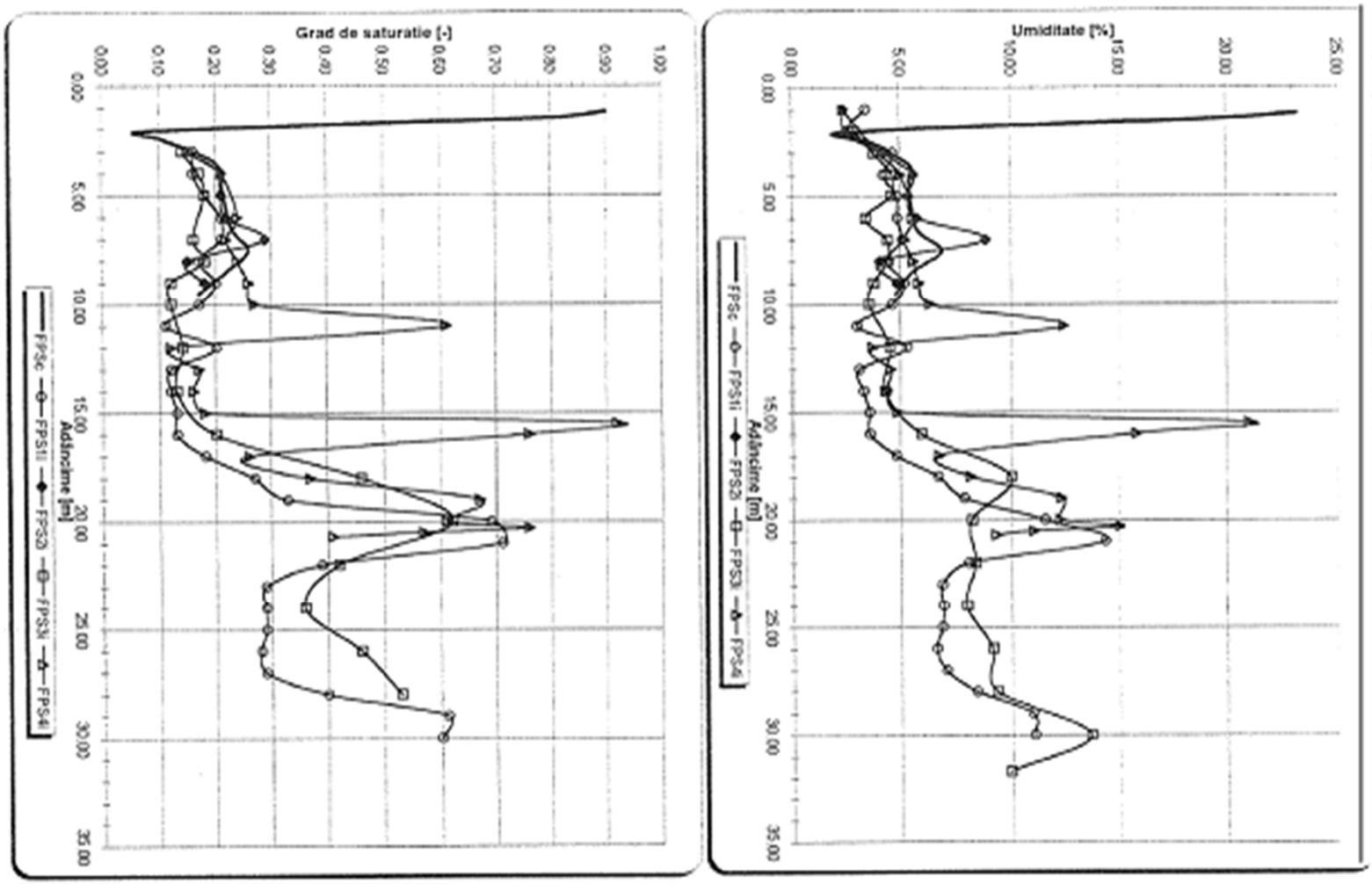
2. Indirect –observatii in constructii vechi, unele de peste 2000 de ani,analogii ale constructiei viitorului deposit pentru deseuri radioactive.

1.Determinari pe probe recoltate din foraje. Cernavoda.Monitoring de umiditate

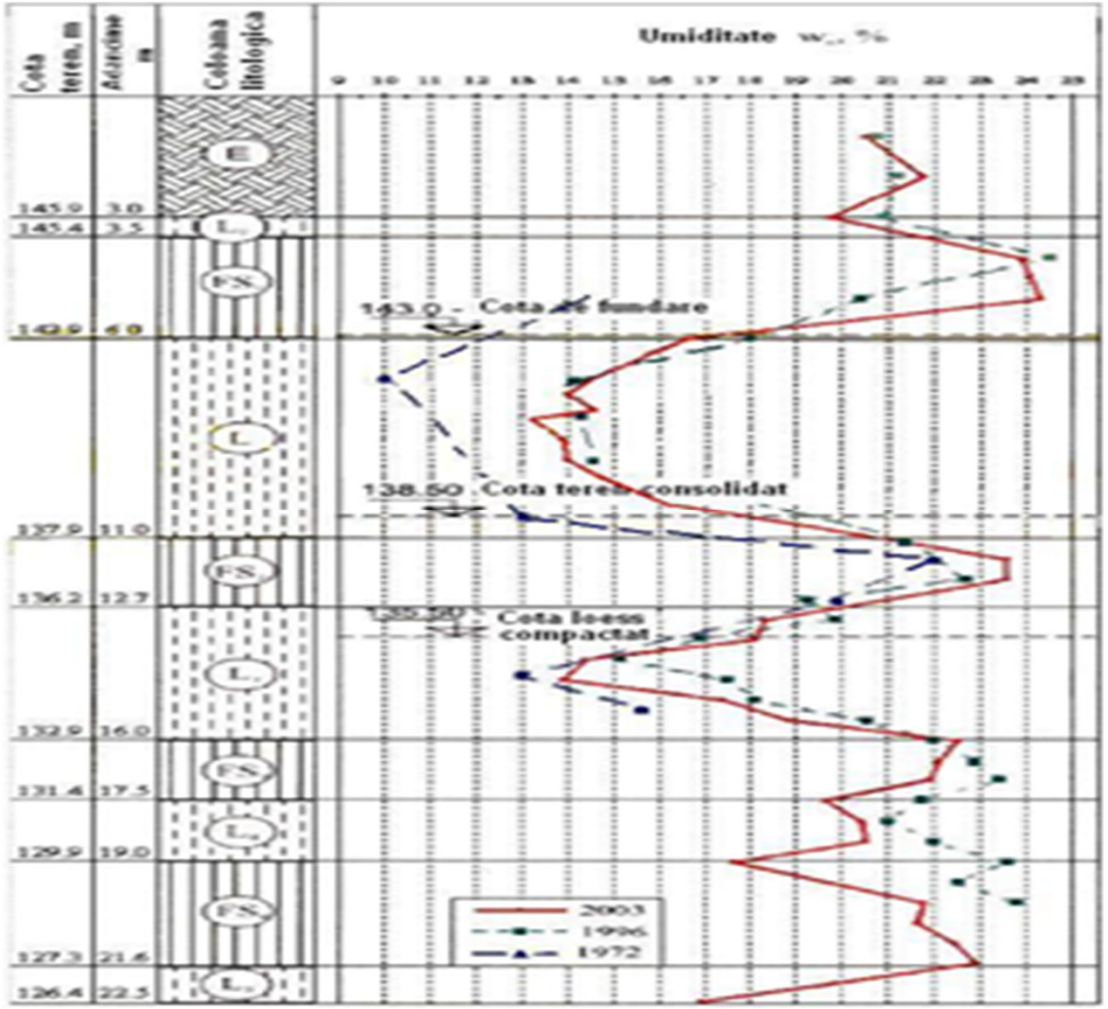


Determinari pe probe recoltate din foraje.

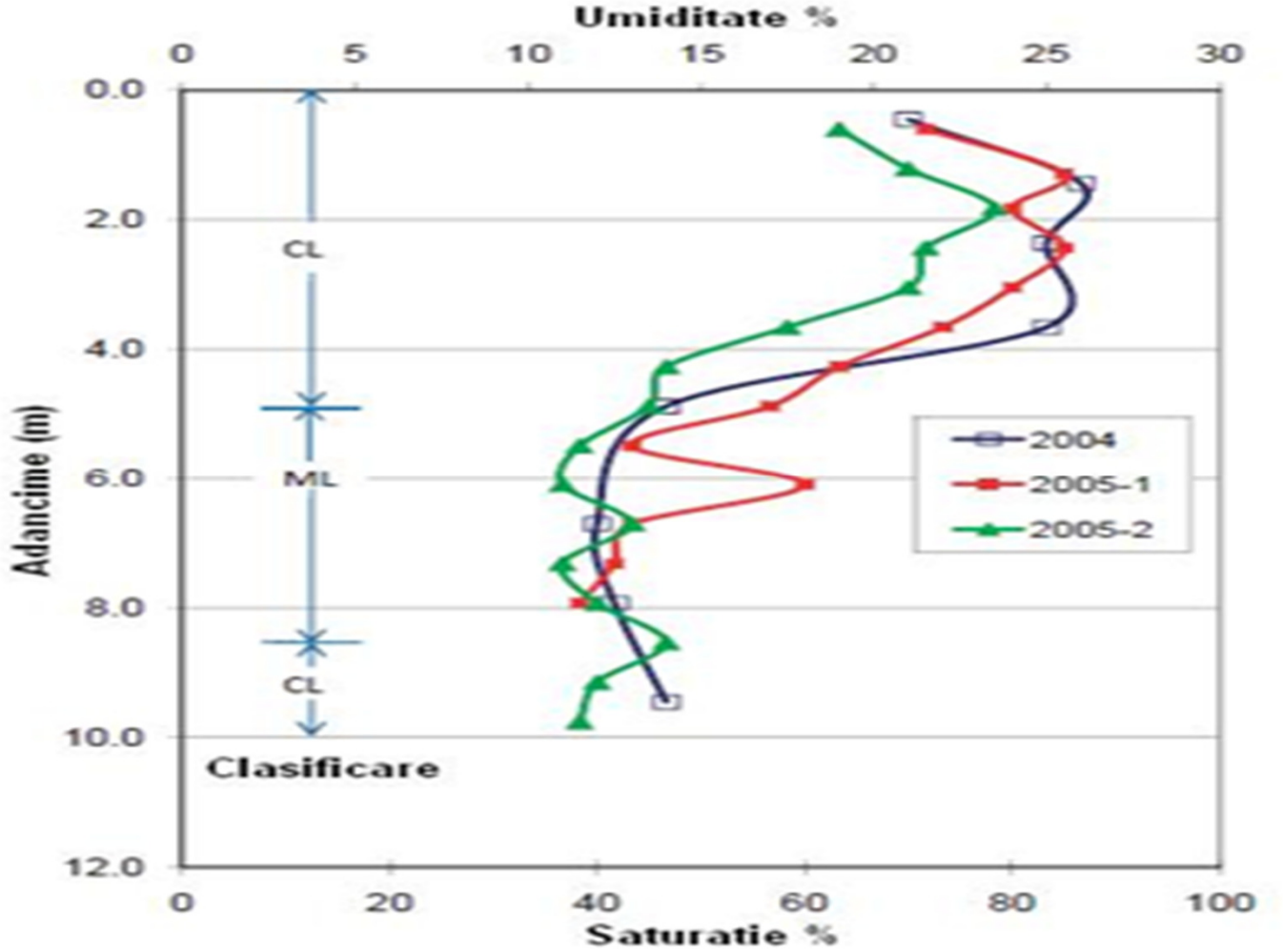
rup infiltrometric cernavoda.



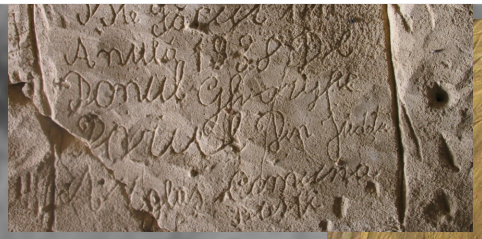
1.Determinari pe probe recoltate din foraje
Ruse(Bulgaria).Fundatia turnului de televiziune



1.Determinari pe probe recoltate din foraje
Kansas(sua),AUTOSTRADA Wyandote county



ID2



Proba	Umiditatea w (%)	Densitate in stare naturala		rw (g/cm3)	
	Densitate in stare uscata		rd (g/cm3)	Porozitate	
n (%)	Indicele porilor	e	Grad de saturatie		Sr
P1	0.78	1.483	1.472	44.7	0.81	0.026
P2	0.84	1.438	1.426	46.4	0.87	0.026
P3	1	1.688	1.671	37.2	0.59	0.045
P4a	0.73	1.594	1.582	40.5	0.68	0.029
P4b	0.52	1.574	1.566	41.1	0.70	0.020

1.Galerie sapata in loess in 1938.Saligny.

Slide 11

ID1 ION DURDUN, 11/20/2014

ID2 Probe recoltate din peretii galriei
ION DURDUN, 11/20/2014

Platoul central loessoid - China

Galerie sapata in loess.Vickburg.SUA folosita ca adapost pentru locuitorii orasului in razboiul civil american

AIEA de la Viena recomanda studiul analogiilor in gasirea unor solutii pentru depozitarea finala a deseurilor radioactive.

Constructiile milenare ingropate in loess,executate cu loess,ce dainuiesc si azi pot oferi exemple.

Chiar daca nu au folosit in activitatea lor computerul,Proctor-ul,excavatorul etc.locuitorii mioritici au realizat cu maiul,sapa si piciorul(“de oaie”) asemenea structuri.Bunul simt tehnic,responsabilitatea lucrului bine facut sunt notiuni ce au suplinit lipsa metodelor modern.

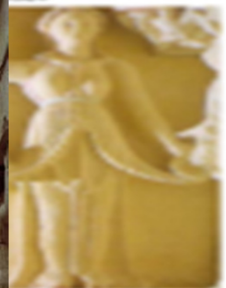
Descifrarea activitatii umane din trecut,prin investigarea stiintifica a vestigiilor conservate pana azi,poate oferi solutii de bun simt pentru constructiile viitoare.

ID3

Sveshtary Thracian tomb

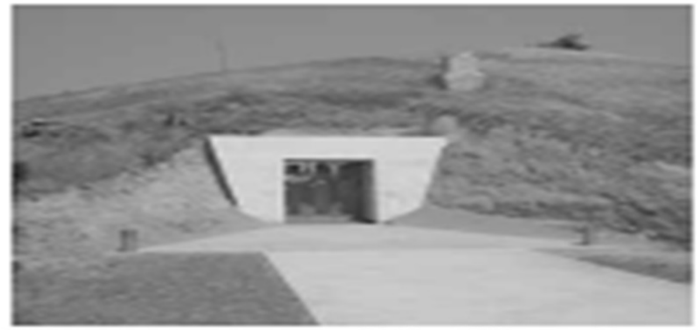
Realizat **in** loess

Mormantul lui Dromichetes

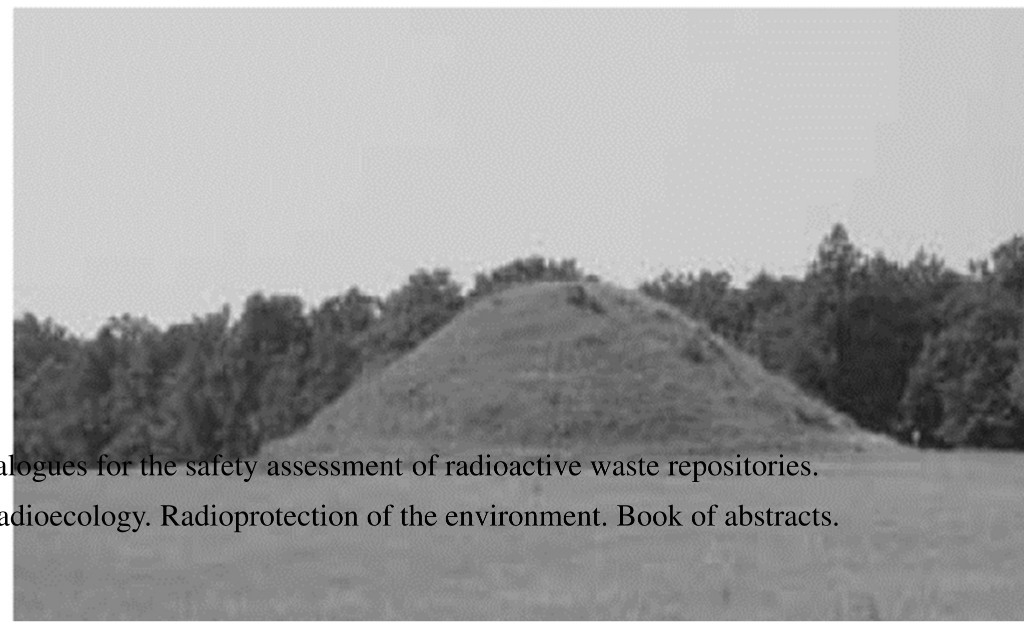


The investigations on the influence of the natural factors determined the constant temperature conditions and the humidity regime, and proved the lack of salt and water movement, which is usually in the basis of destruction process. These investigations included application of microbiological, luminescent, UV and thermo graphic methods for documenting the status of the monument. The information about

Photo 3: No traces of soluble substances



The entrance of theThracian Tomb

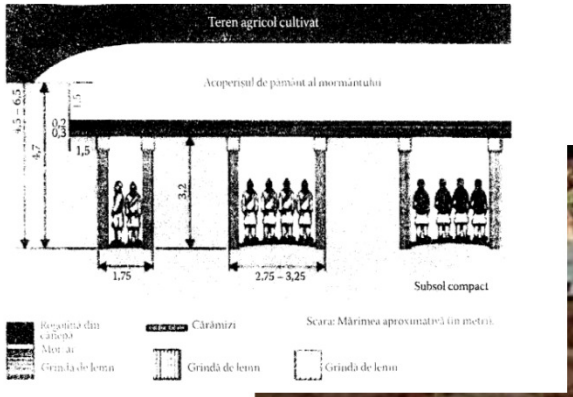


1. Evstatiev, D., D. Gergova, B. Vachev. 2004. Archaeological and geological analogues for the safety assessment of radioactive waste repositories. International symposium INSINUME 2004. In situ nuclear metrology as a tool of radioecology. Radioprotection of the environment. Book of abstracts. Albena 27-30 September 2004, 18.

Slide 15

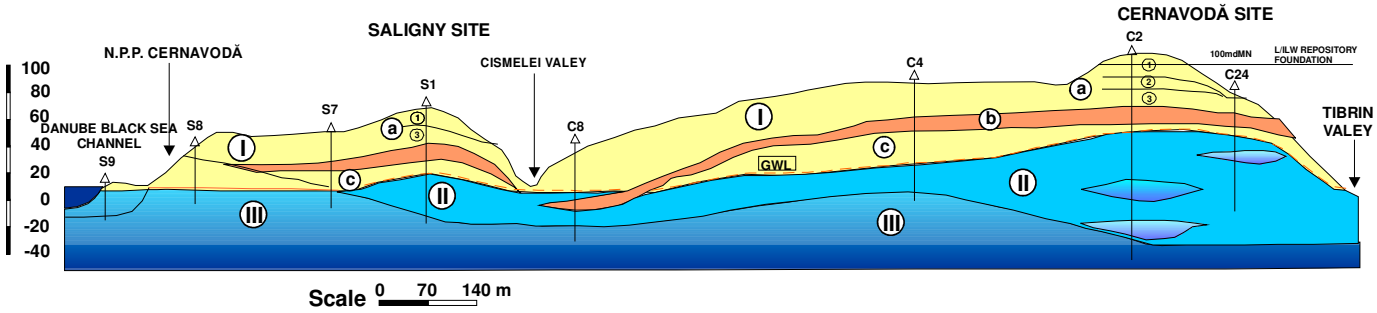
ID3 realizat in loess

ION DURDUN, 11/22/2014



Complexul funerar al lui Shi Huanghdi din Platoul Loessoid-China

CERNAVODA area. Hydrogeological zoning.

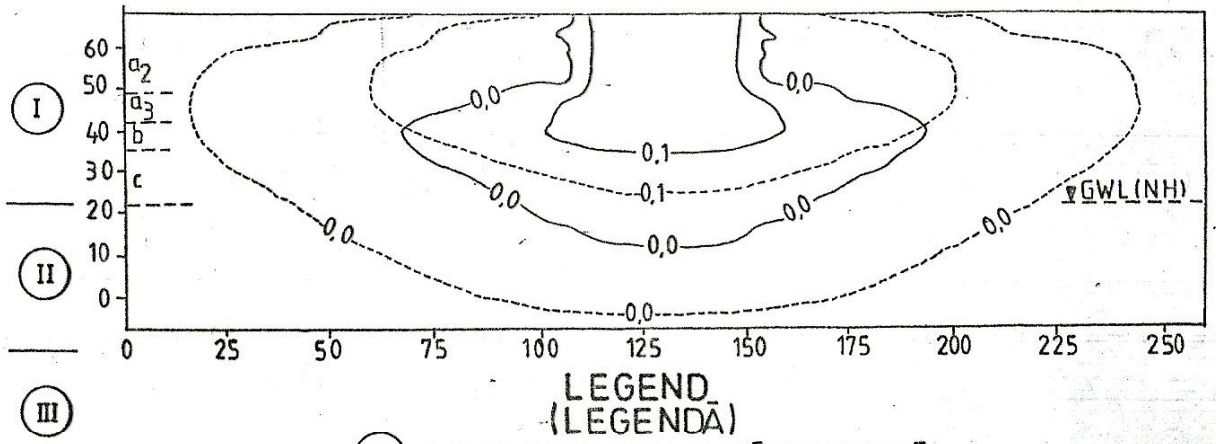


LEGEND

- (I) UNSATURATED ZONE
  - (a) Loess
    - ① upper - S = 0,2 - 0,8
    - ② middle - S = 0,3 - 0,4
    - ③ lower - S → 0,8
  - (b) Cuaternary red clay - S = 0,9 - 1,0
  - (c) Precuaternary clays with sand and limestone lenses
- GWL Ground water level
- (II) SATURATED ZONE
- Local aquifers
- (III) MAIN AQUIFERS (Baremmians limestone)

L/ILW-SALIGNY SITE
D.F.D.S.M.A.-SALIGNY

TRITIUM MIGRATION AFTER 300 YEARS
DISTRIBUTIA CONCENTRATIEI RELATIVE
DE TRITIU DUPĂ 300 ANI



LEGEND
(LEGENDĂ)

(I) - UNSATURATED ZONE - ZONĂ NESATURATĂ

- (a) loess { 2 - midle - mediu S=0,2-0,4 ; 3 - lower - inferior S=→0,8
- (b) quaternary red clays - argile rosii S = 0,9-1,0
- (c) prequaternary red clays - argile precuaternare

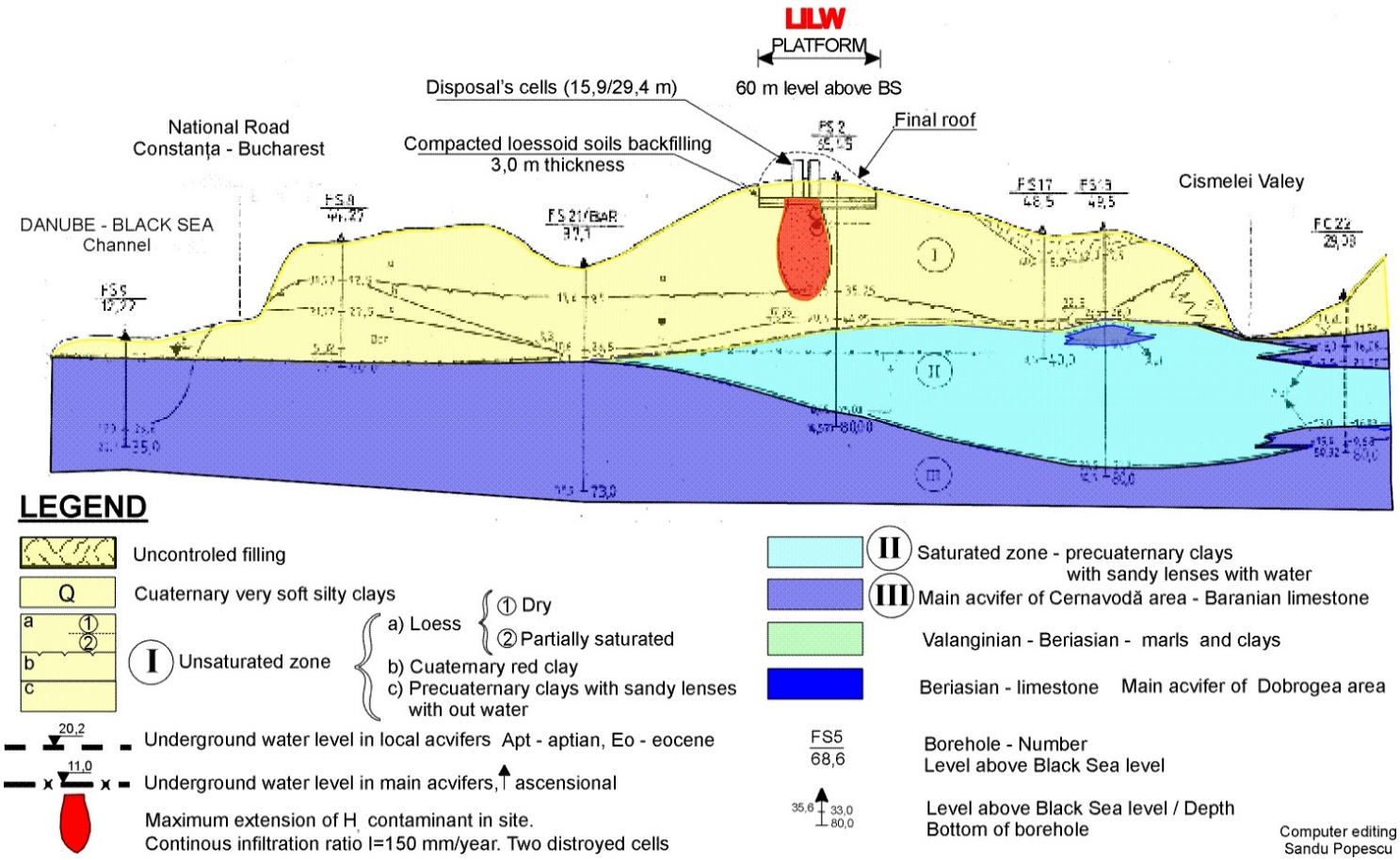
(II) - SATURATED ZONĂ - ZONĂ SATURATĂ
- Prequaternary clays with sandy lenses
- Argile precuaternare cu lentile de nisip cu apă

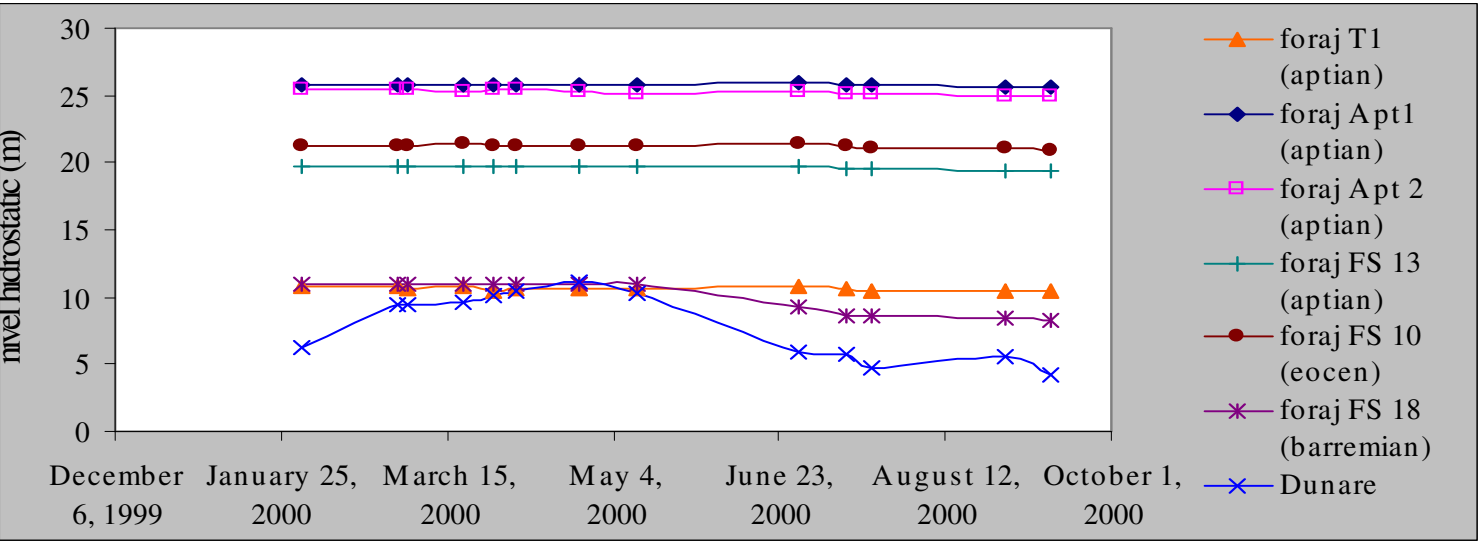
(III) - MAIN AQUIFER - BARREMIAN LIMESTONE
- ACVIFERUL PRINCIPAL AL ZONEI - CALCARUL BARREMIAN

MAIN GEOLOGICAL(natural) BARRIER

- Unsaturated zone, including dry subzone and the red clay -

Total protection of the main aquifer - Safety assesment for Saligny site

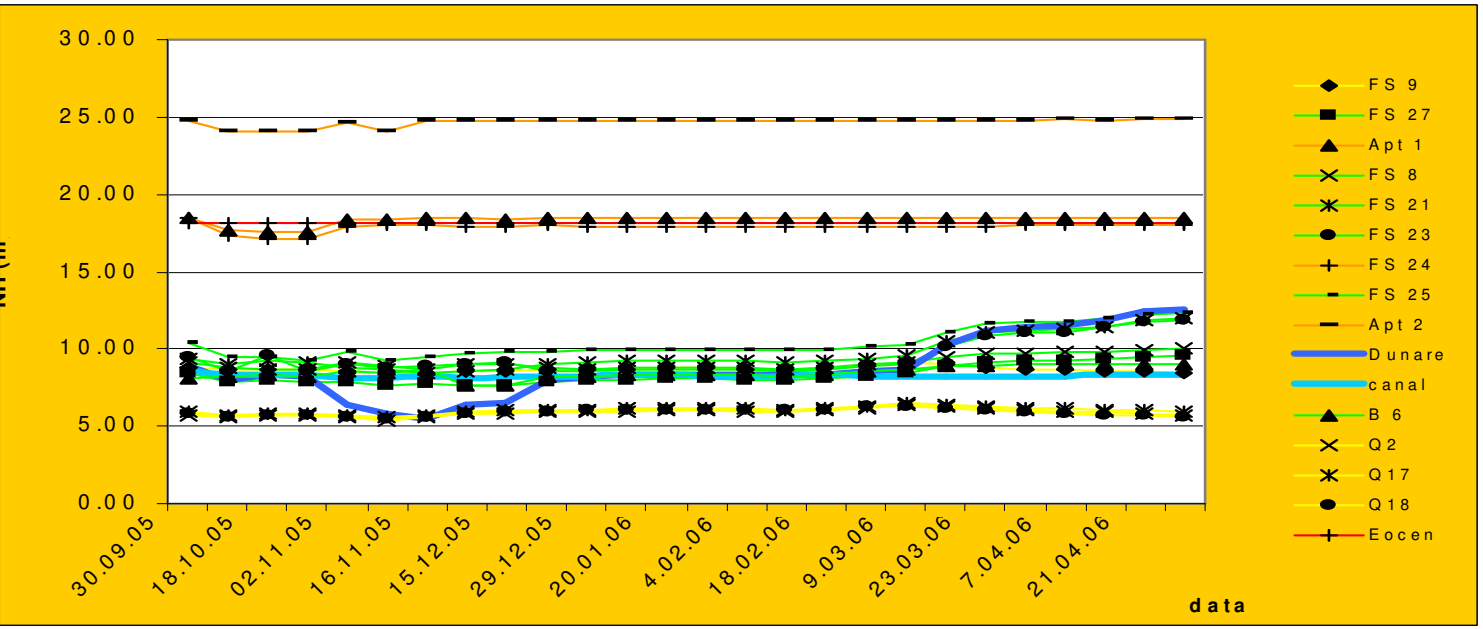




Variatia nivelului apei actual sub zona nesaturata

Acviferele

interfluviului Dunare-Valea Cismelei si raportul cu Dunarea si canalul Dunare-Marea Neagra.



-locale

cantonate in lentile nisipoase sau calcaroase aptiene sau eocen **izolate**.

-regional

cantonat in calcarul beriasian in raport direct cu Dunarea(cu variatii de pana la 10-14 m)si Canalul Dunare –Marea Neagra(constant)

MINIMUM DISTURBANCES CONCEPT IN SALIGNY SITE

According to the Minimum Disturbance (MD) Design philosophy (as stated by Dr. Carl-Olof Morfeldt, Mine consult-Sweden), it is a good practice to proceed with a significant knowledge of geology in order to adapt engineering approaches to nature; in fact, this is considered to be a fundamental principle.

The implementing process of the disposal's construction (structures) in host geology of Saligny

inside actual morphology and dry zone

with minimum disturbance of environment will respect the following:site inside

- **the maintenance of the actual natural conditions(morphology and moisture content)** *by*

  a) minimum excavations and use of the excavated loessoid material as: *backfill material* which is compacted and treated under cells disposal; *filling material* between cells (e.g. treated with bentonite); *final roof layers material*

  b) minimum settlements of the foundation - limited maximal load of construction is about 2.5 daN/cm^2.

  c) constructing a long term roof designed inside of the actual morphological line of the hill with continuous slopes from the top of the disposal facility to natural slopes;

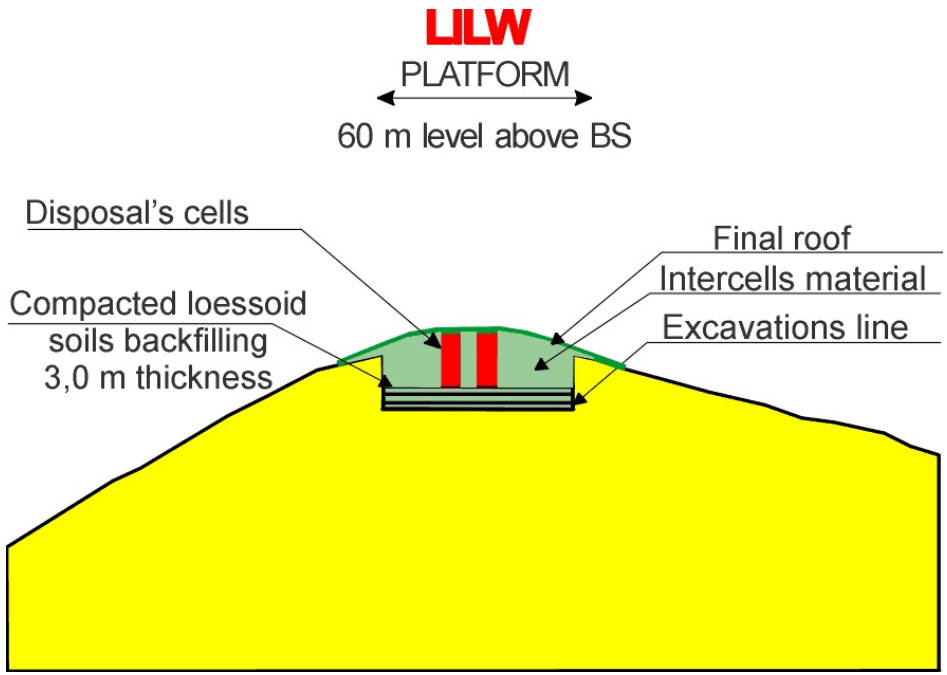
  d) using natural methods (planting grass and shrubs) or

  e) geo-syntetics .

- **minimum presence of the water in the loessoid massif** - all of the disposal components including visiting gallery, water pipe line and others will be inside of the compacted loessoid soils in perfect tightness conditions.

SALIGNY SITE

MINIMUM DISTURBANCES DESIGN = MINIMUM DISTURBANCES OF ENVIROMENT



General view of repository (Conceptual Design)