Long-term behavior of corium after the accident (using the data of the Chernobyl NPP accident)

"CHESS-2" – anticipated Project of the ISTC #3702

CONTENT

- Objectives of new Project and its interface with Project #2916 (CHESS-1)

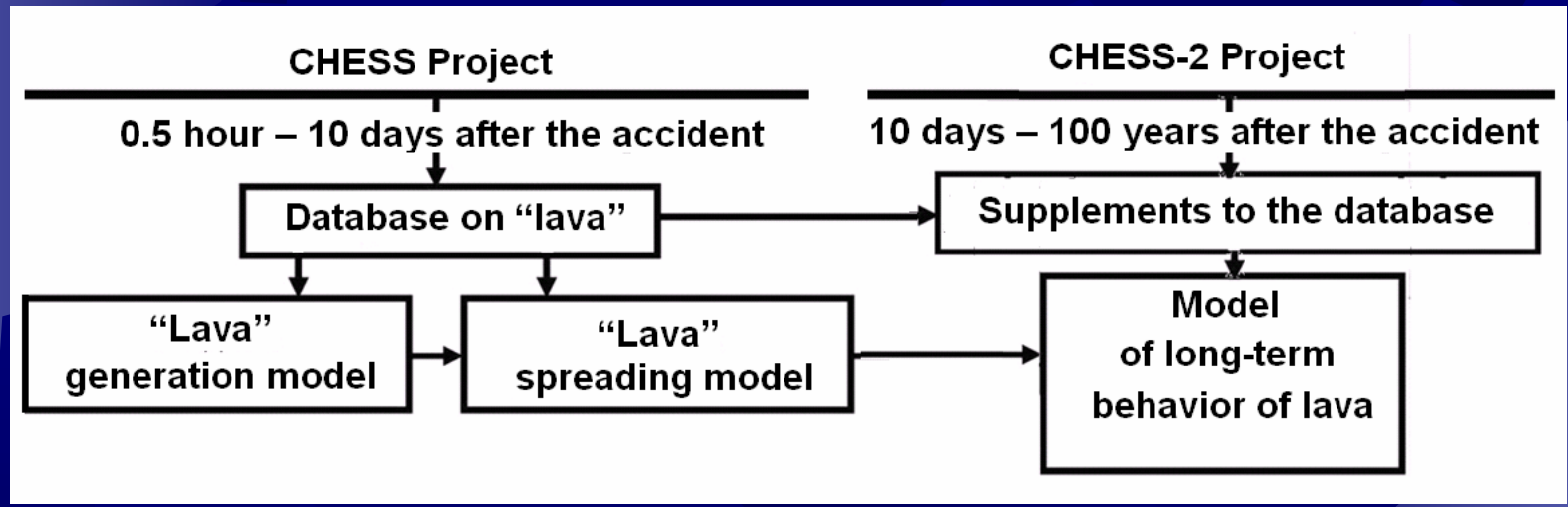
- Tasks of the Project

- Interface with STCU Project # 4207 “Long-term prognosis of transformation of the fuel-containing materials (FCM) in Chernobyl Shelter”

General objectives of CHESS Projects

- **Data acquisition on corium properties at characteristic phases of its behavior (periods: immediately after the accident and next – during the following 20 years)**
- **Simulation and long-term prediction of the behavior of "lava" up to 100 years ahead in the course of its storage in the "Shelter" under the new confinement**
- **Elaborating recommendations on safety measures during storage and ultimate removal of "lava" from the "Shelter"**

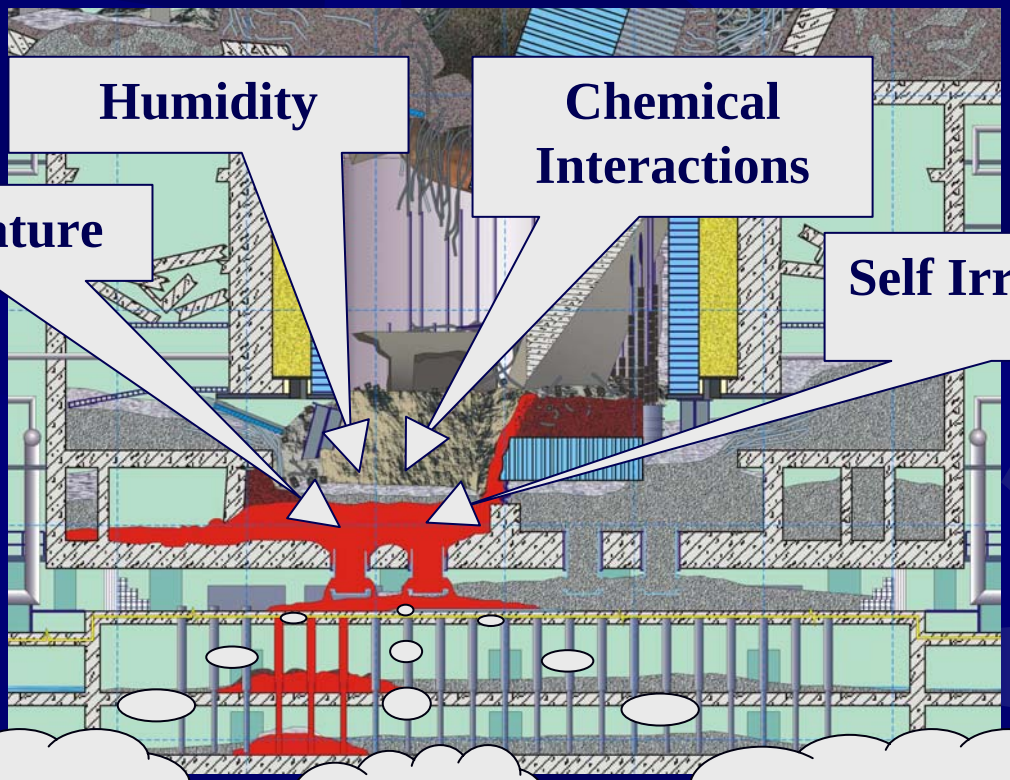
CHESS-1 and CHESS-2 interface



Practical application

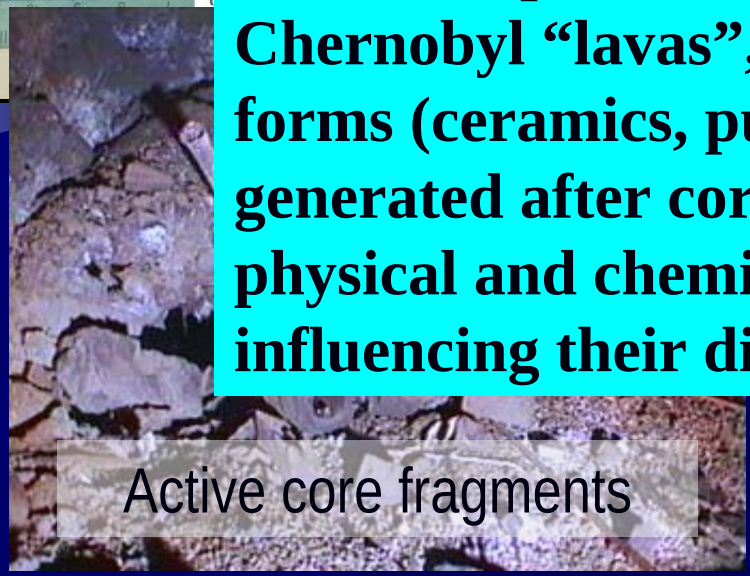
- **In case of severe reactor accident resulted in corium formation, there is no practical opportunity to withdraw quickly fuel containing material outside the Unit, or properly isolate it (like in case of the ChNPP).**
- **What can we expect from the accidental fuel inside the building from the viewpoint of the LFCM transformation?**
- **How much time do we have before drastic measures for fuel withdrawal / isolation will be necessary?**
- **What sort of corium will we have to the time of its withdrawal and disposal of?**

Chernobyl experience

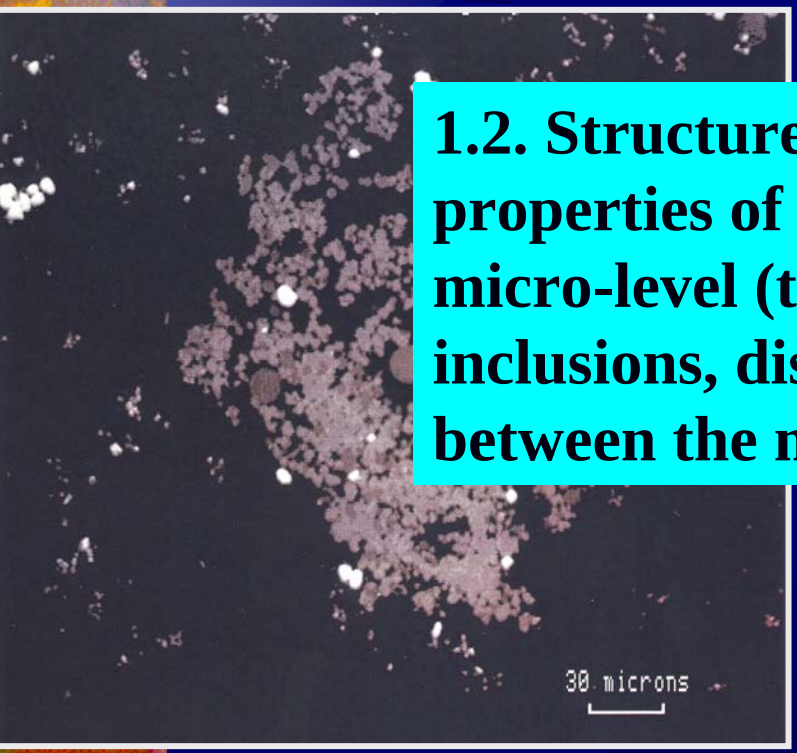


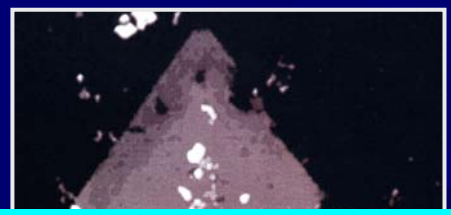
Task 1. Main macro- and micro properties of Chernobyl lava

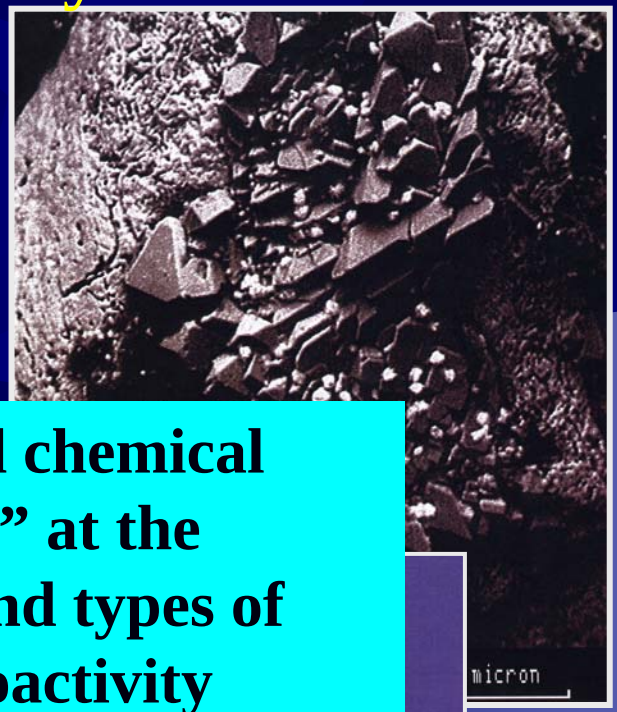
1.1. Description of macro-properties of Chernobyl "lavas", their different types and forms (ceramics, pumice, slag, etc.) generated after corium solidification, of physical and chemical properties and factors influencing their distinctions

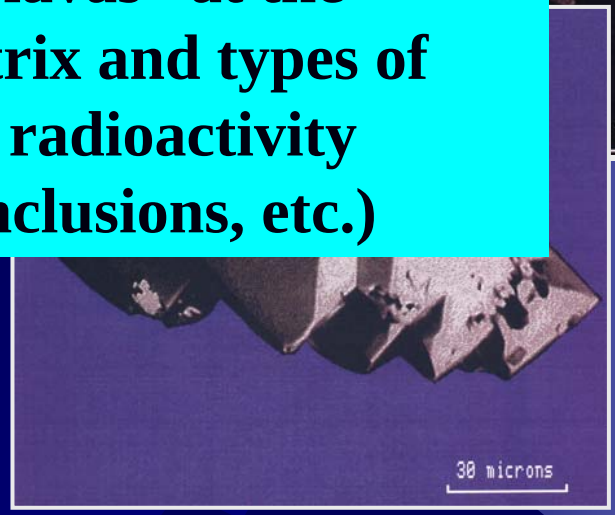


Task 1. Main macro- and micro properties of Chernobyl lava





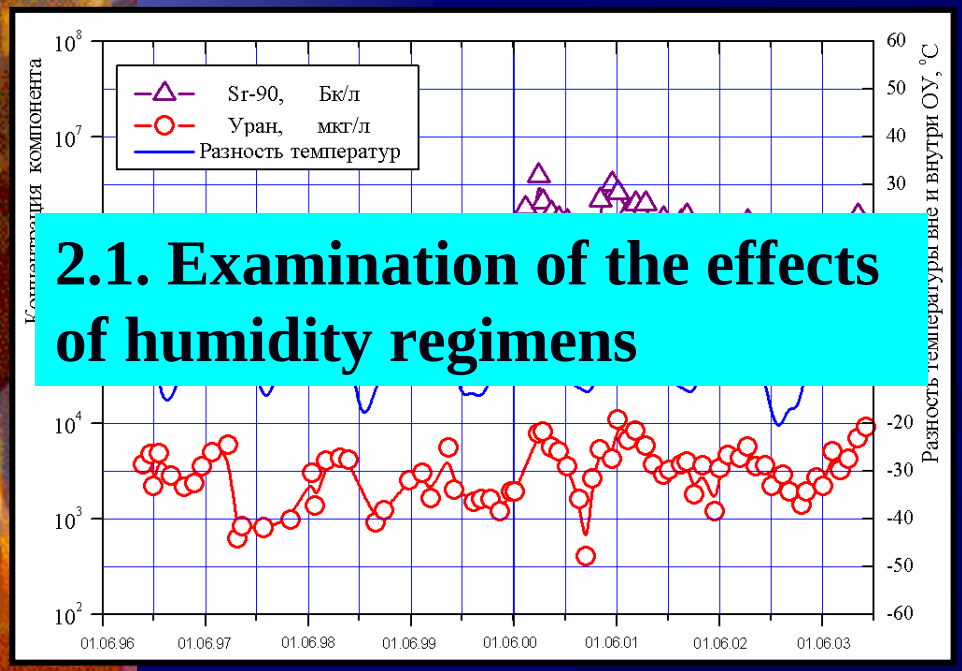




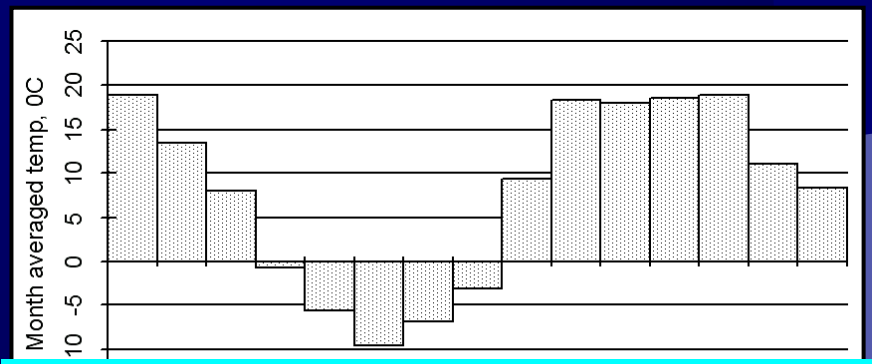
1.2. Structure and physical and chemical properties of Chernobyl "lavas" at the micro-level (the main matrix and types of inclusions, distribution of radioactivity between the matrix and inclusions, etc.)

Task 2. Studying external and internal factors influencing the long-term condition of different-type “lavas

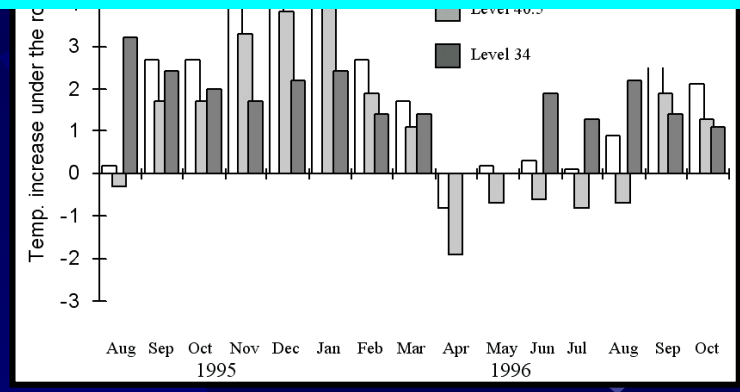
- Humidity variations;
- Temperature variations



2.1. Examination of the effects of humidity regimens

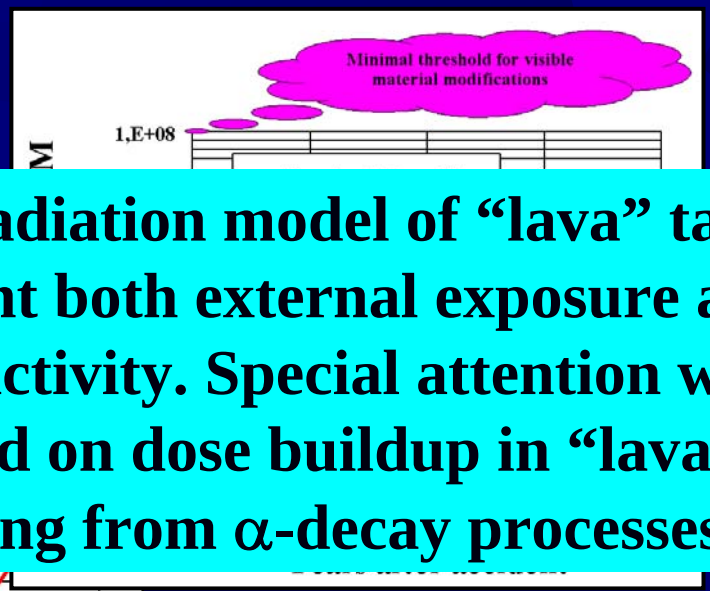


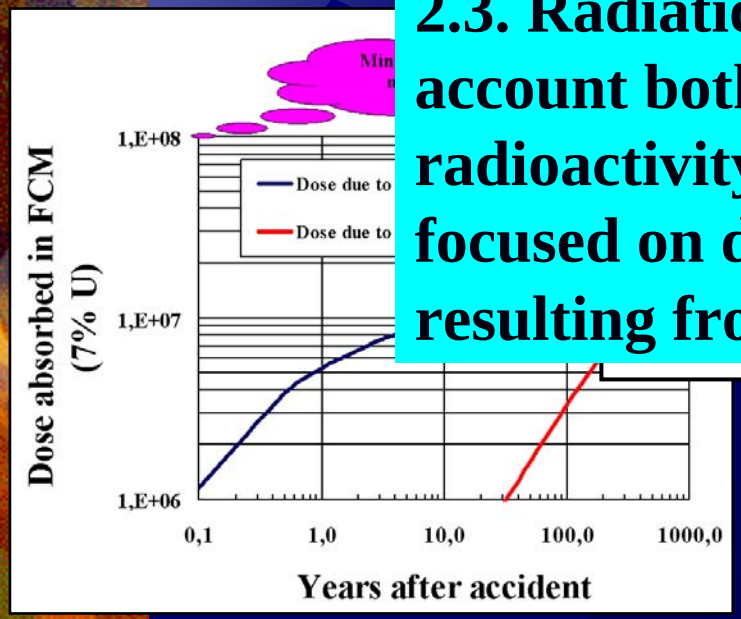
2.2. Examination of the effects of temperature



Task 2. Studying external and internal factors influencing the long-term condition of different-type of “lavas

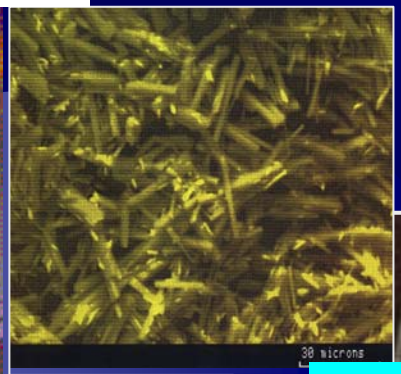
- Radiation model (external and self irradiation, accumulation of the defects in the material)
- Most significant mechanisms for destruction



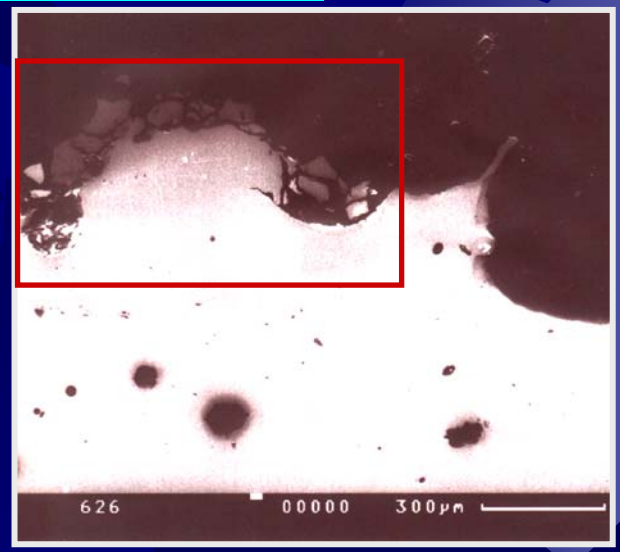


2.3. Radiation model of “lava” taking into account both external exposure and its own radioactivity. Special attention will be focused on dose buildup in “lava” material resulting from α-decay processes

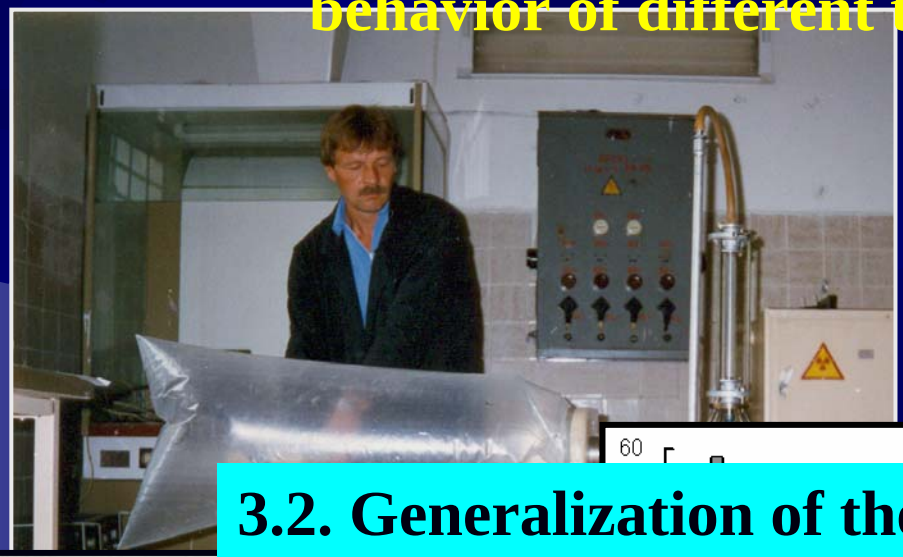
Task 3. Analysis of direct experimental investigations into the long-term behavior of different types of “lava”



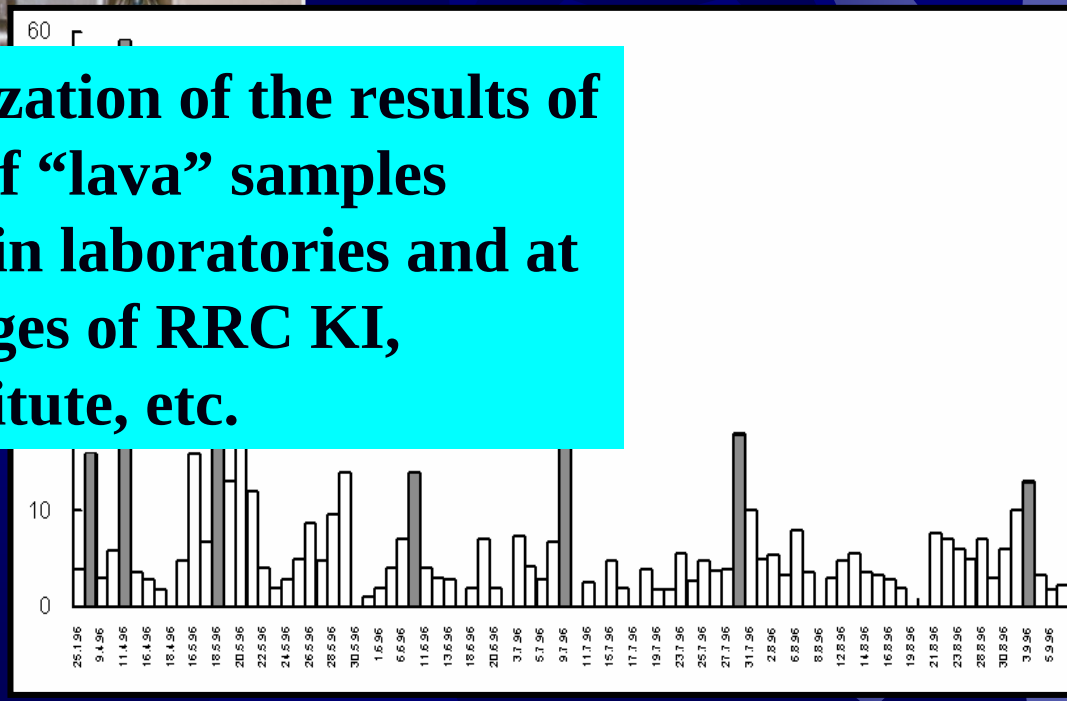
3.1. Investigations at the “Shelter”



Task 3. Analysis of direct experimental investigations of the long-term behavior of different types of “lava”



3.2. Generalization of the results of monitoring of “lava” samples having been in laboratories and at special storages of RRC KI, Radium Institute, etc.



Task 4. Study of existing LFCM analogues and results of their studies under long-term storage

4.1. Collection and analysis of the data on vitrified waste
4.2. Identification of waste types similar to “lavas” and their properties

Task 5. Model of the long-term behavior of corium

5.1. Establishing the dependence of dynamics of solidified corium behavior on variations in its internal composition and external conditions at present.

5.2. Usage of calculation, theoretical and experimental data obtained for vitrified waste to generate corium behavior model.

Resources required

Participating personnel	**19 (13 “weapon” scientists);**
Project duration	**30 months;**
Estimated cost	**345,000 USD**