Dynamics of Uranium Ore Formation in the Basement and Frame of the Streltsovskaya Caldera

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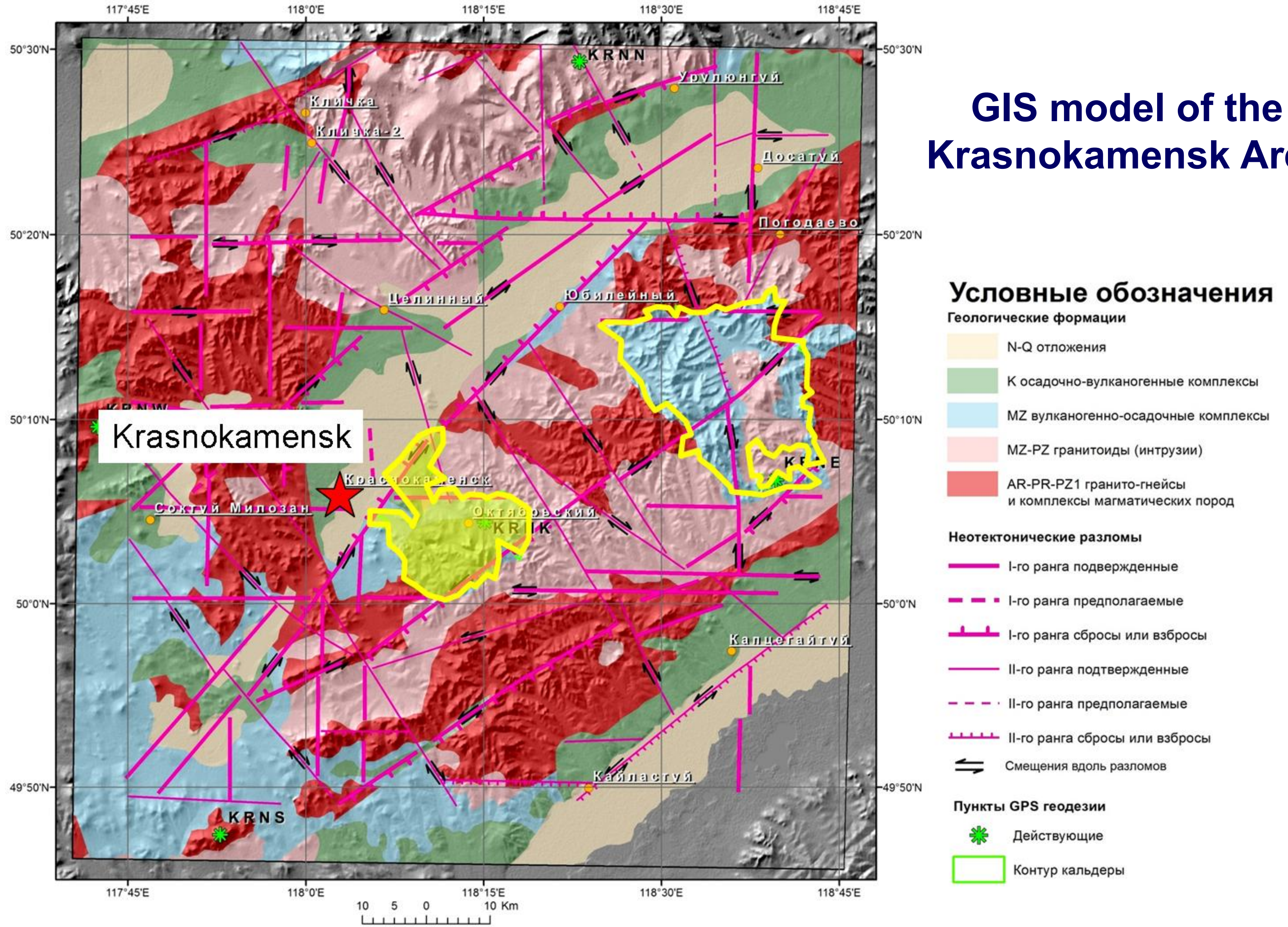
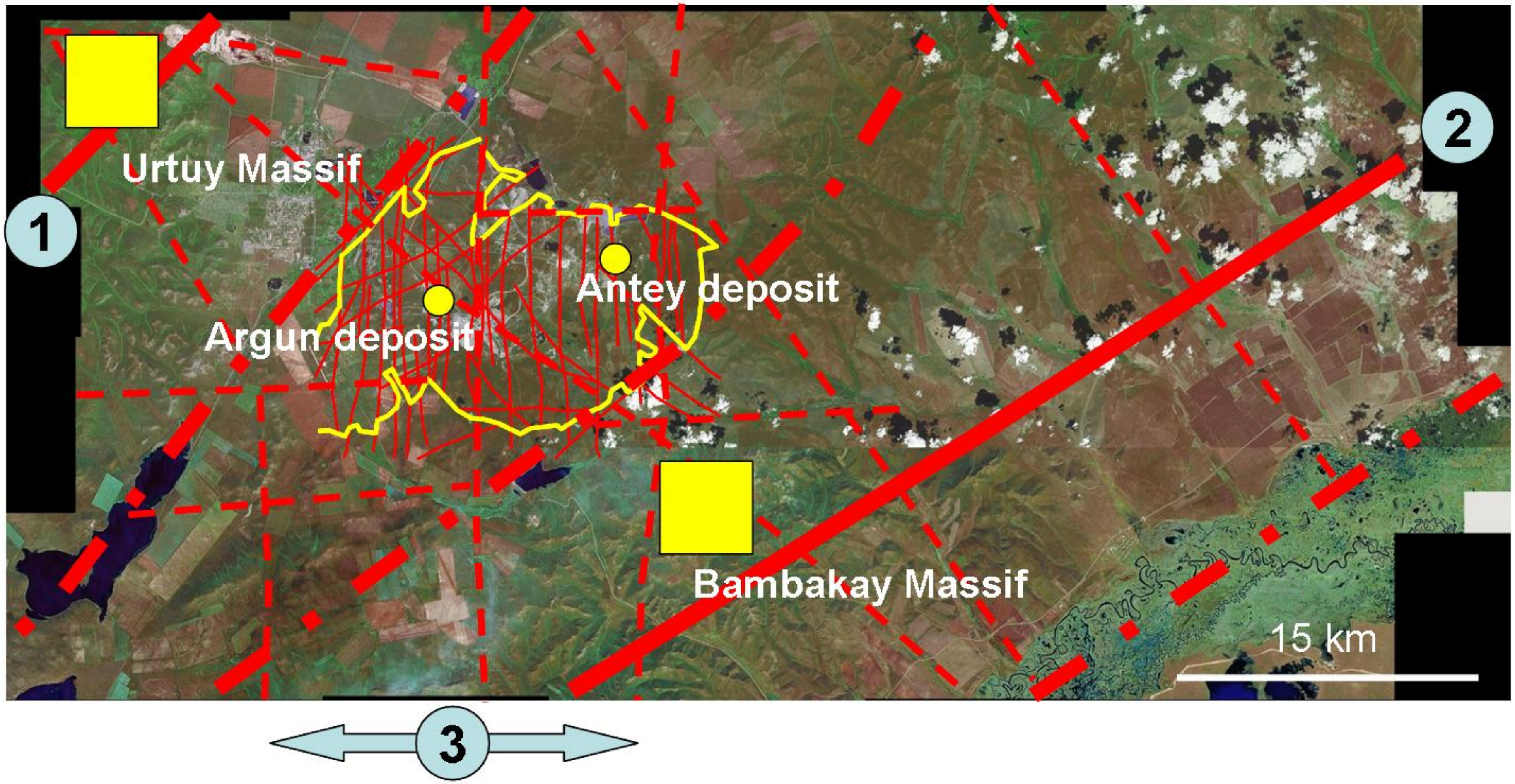
Geographical location of the Transbaikalian Region and Krasnokamensk (Hongshi) Area

GIS model of the Krasnokamensk Area

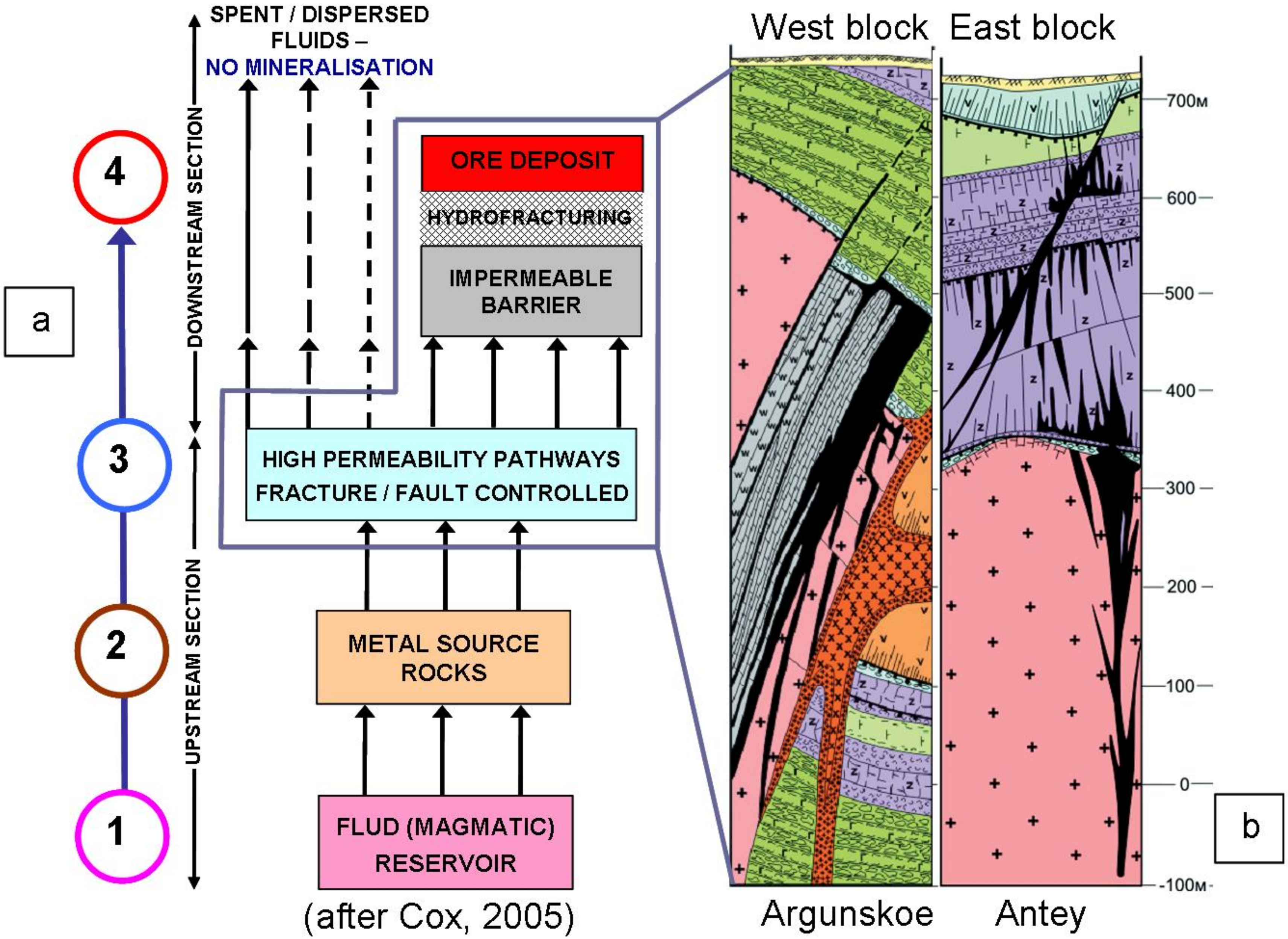


Satellite view of the Area with the main faults and caldera edge, and sites under consideration

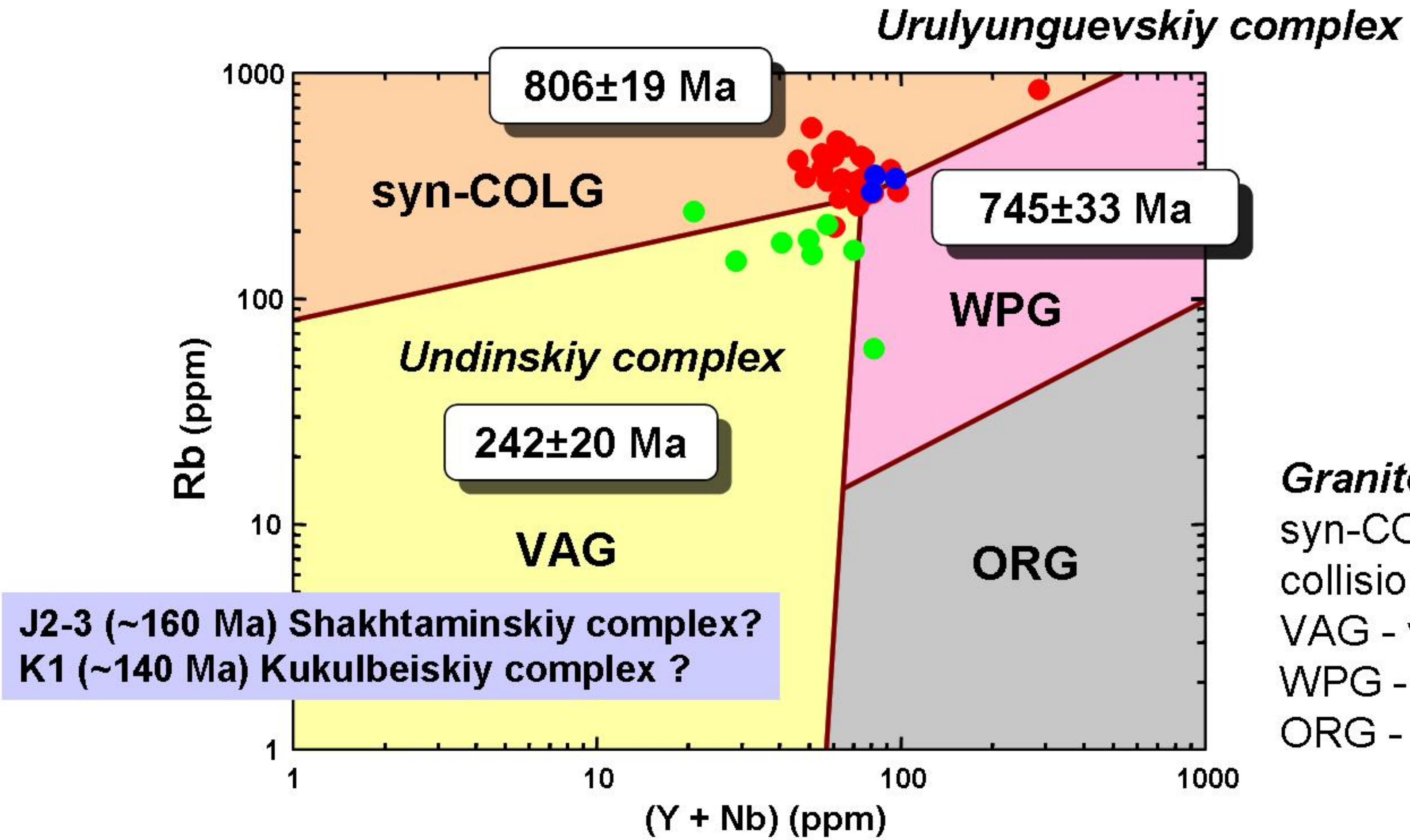


Main Fault Zones: 1- East Urulunguy, 2- South Argun, 3- Dalaynor-Gazimur

Main elements of ore-forming fluid-magmatic system (a) and location of U deposits in the basement of the Streltsovskaya caldera (b)



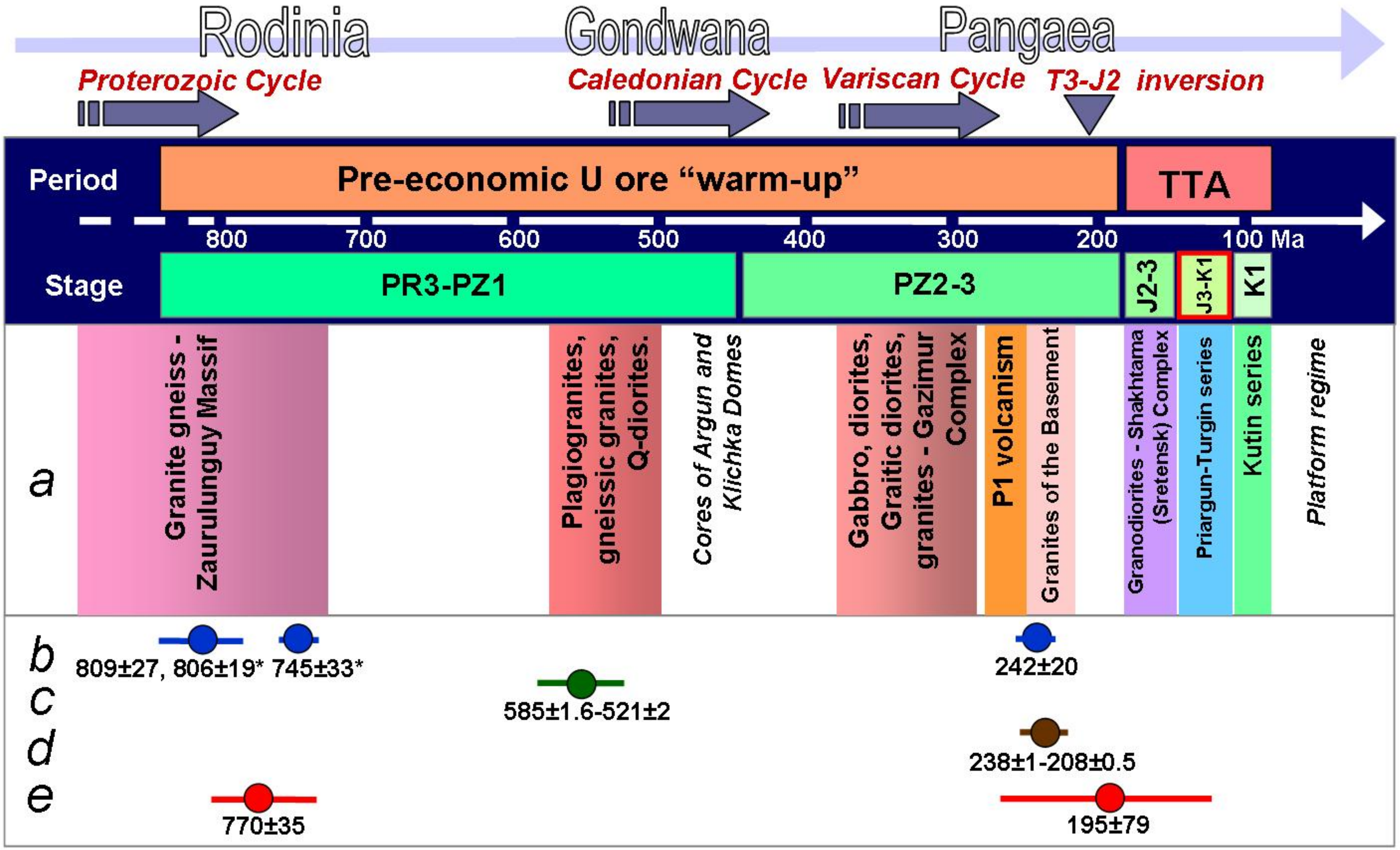
Discrimination diagram for granitoids of the Streltsovskaya caldera basement and frame



Granites:
syn-COLG - syn-collisional
VAG - volcanic-arc
WPG - within-plate
ORG - ocean-ridge

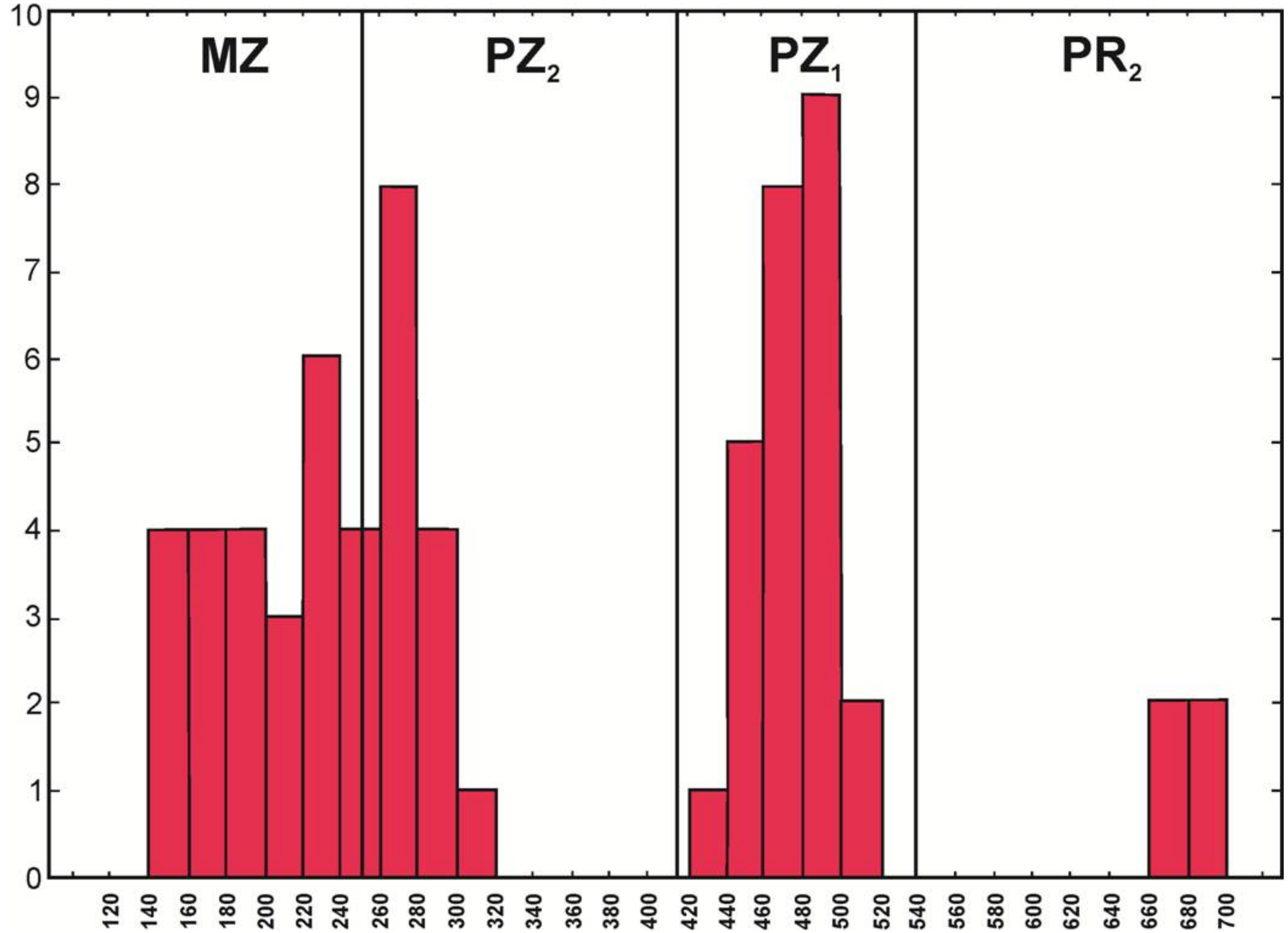
NW Frame - Urtuy Massif (red dots) , SE Frame – Bambakay Massif (blue dots), Basement (Antey U deposit) of the Caldera (green dots).
MZ granitoids are not spread and geodynamic setting are not specified.
Field boundaries taken from Pearce et al., 1984.

Regional tectonomagmatic and mineral events



a –igneous and volcano-sedimentary complexes, b - zircon (U-Pb), c - muscovite (Rb-Sr), d – biotite (Rb-Sr), e – uraninite (U-Pb). Ages defined by V.N. Golubev (IGEM RAS and CRPG) and *TU Bergakademie Freiberg. TTA – tectonothermal activation.

“Chemical” age of uranium oxides in the vicinity of the Streltsovskaya caldera (after Laverov et al., 2012)



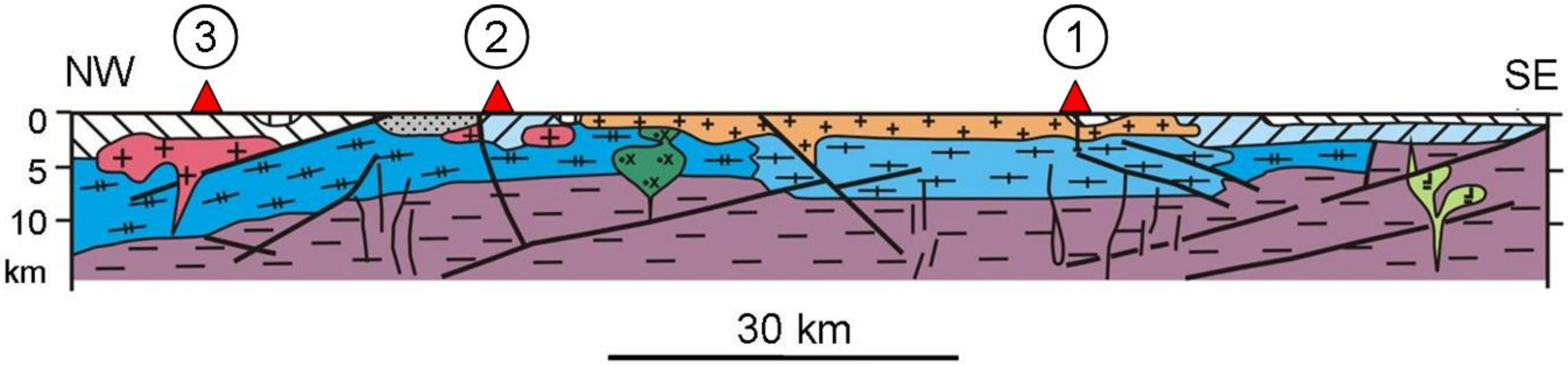
Th-uraninite
Nb-nasturane
REE-uraninite

Y-uraninite
Th-Y-uraninite

REE-Th-uraninite

Y-uraninite
Th-uraninite

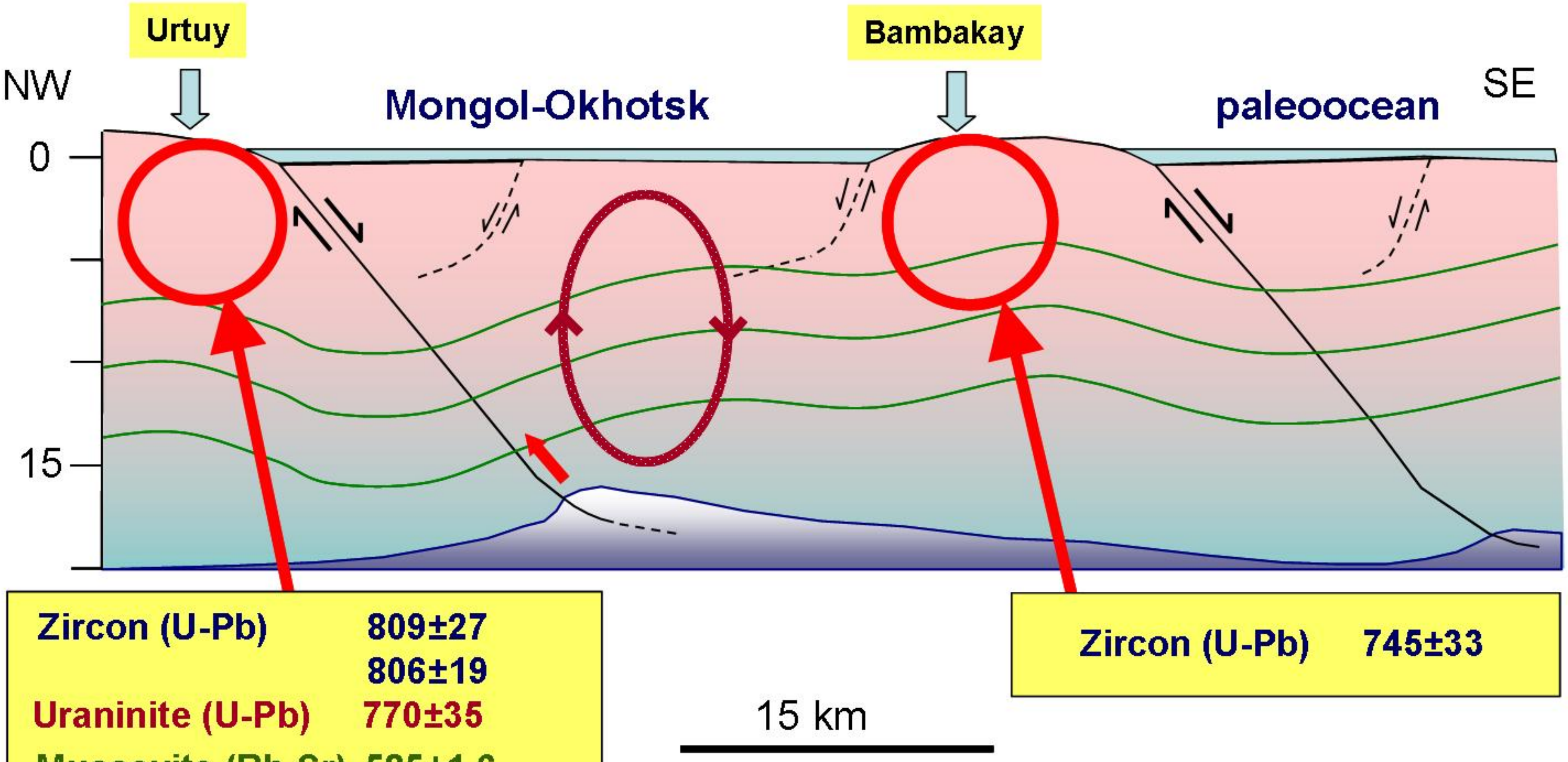
SE-NW seismic profile along the main ore fields of the Argun (Erguna) Massif and Gazimure terraine (after Dukhovskiy et al., 1998)



Ore Fields: 1 – Krasnokamensk (U), 2 – Klichka (Pb-Zn), 3 – Mulino (Au, Pb-Zn)

Episode I: ~800 - 540 - 380 Ma

Fold core, AR-PR granite-gneissic cupola, localization of listric and steeply-dipping faults bounding protograbens, Caledonian granites



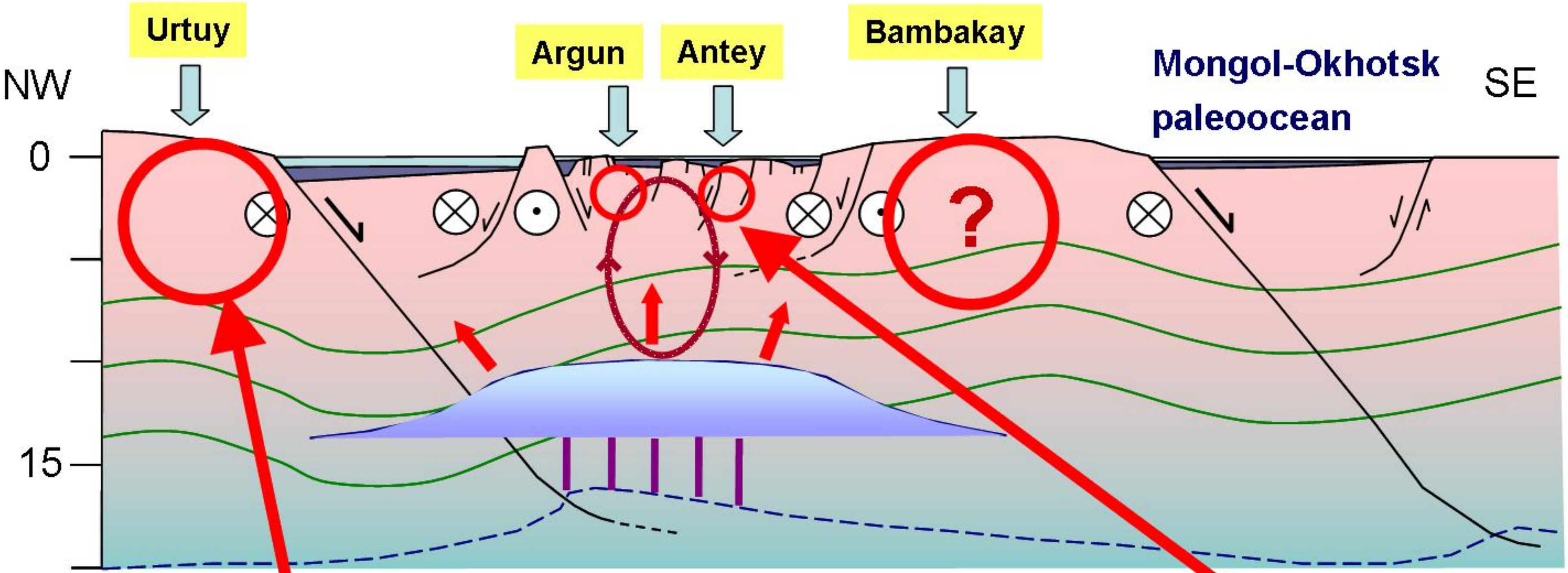
Zircon (U-Pb)	809±27
	806±19
Uraninite (U-Pb)	770±35
Muscovite (Rb-Sr)	585±1.6
	577.7±1.4
	521±2

Zircon (U-Pb)	745±33

Limiting temperature of isotopic system stability:
420°C- uraninite, 340°C- muscovite, 270°C- biotite

Episode II: 380 – 230 Ma

Variscian granites and onset of protograben in pull-apart regime due to P2-T1 (~ 250 Ma) tectonomagmatic events



Biotite (Rb-Sr)	238±1
	237.2±0.6
	236.2±0.5
	233±7
	208±0.5

Rerun of Rb-Sr system of biotite due to Antey's granite formation?

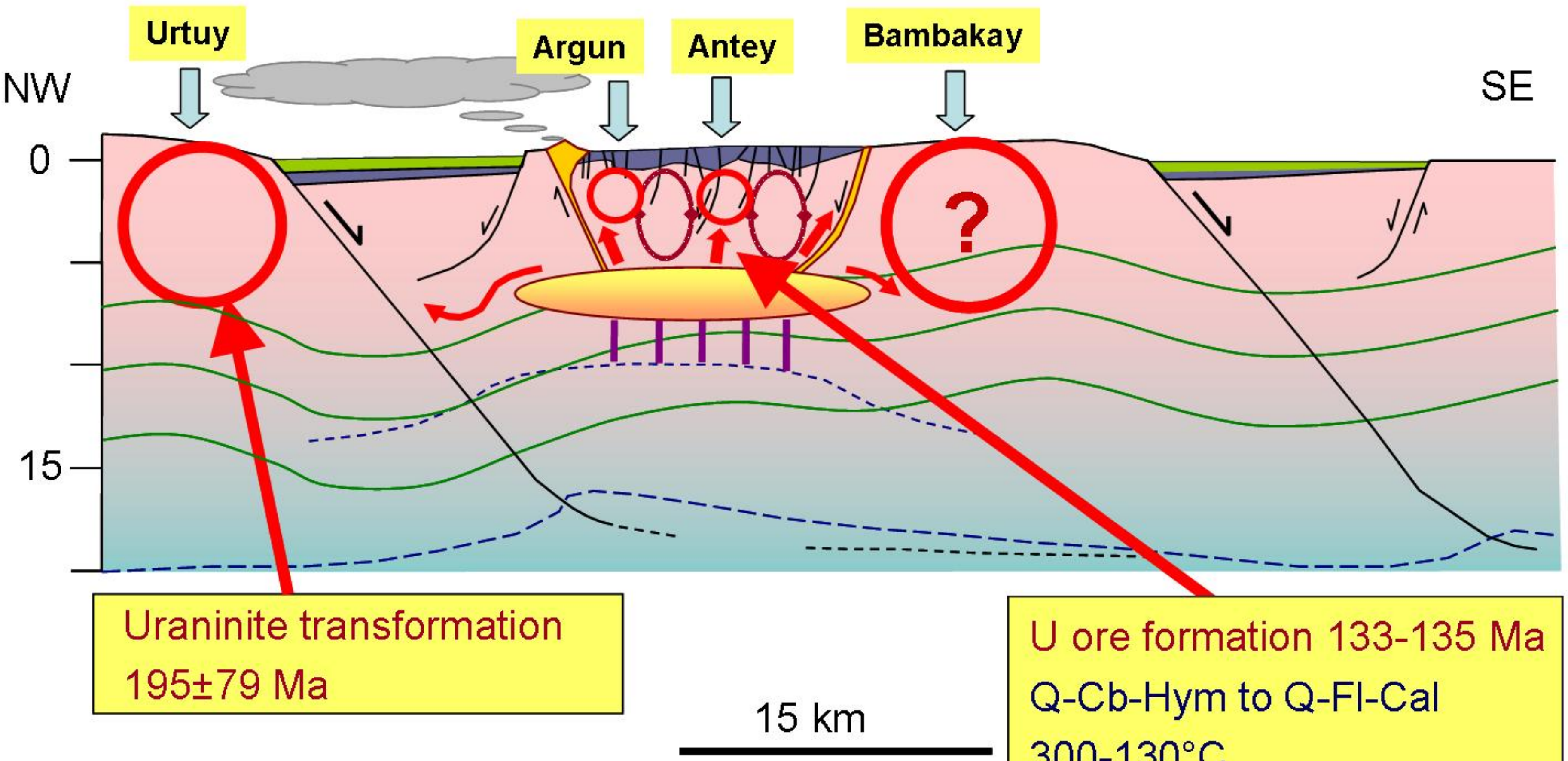
15 km

Zircon (U-Pb)	245.4±5.1
	244.1±2.2
Biotite (Rb-Sr)	233±1.5
	232.1±0.6

U-Pb and Rb-Sr ages are close. Probably there was not later thermal impact to granite more than 300°C

Episode III: 230 – 135 – 100 Ma

Completion of pull-apart graben, tectonic inversion (T3-J2), volcanism-caldera development (J3-K1), formation of flank sedimentary basins (K1)



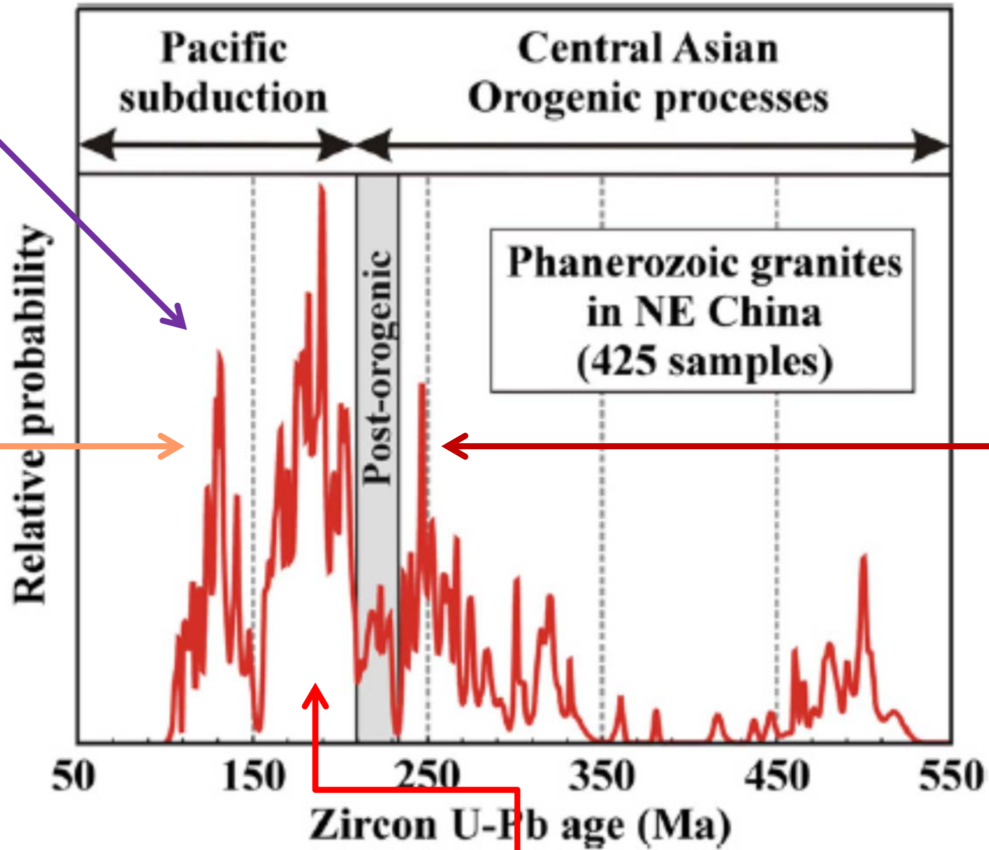
Uraninite transformation
195±79 Ma

U ore formation 133-135 Ma
Q-Cb-Hym to Q-Fl-Cal
300-130°C
U-ore stage 215-190°C

In connection with Variscan granite or later?

Age probability plot of the Phanerozoic granitoids in NE China (after Wu et al., 2011)

Caldera U ores:
136 ± 3 Ma

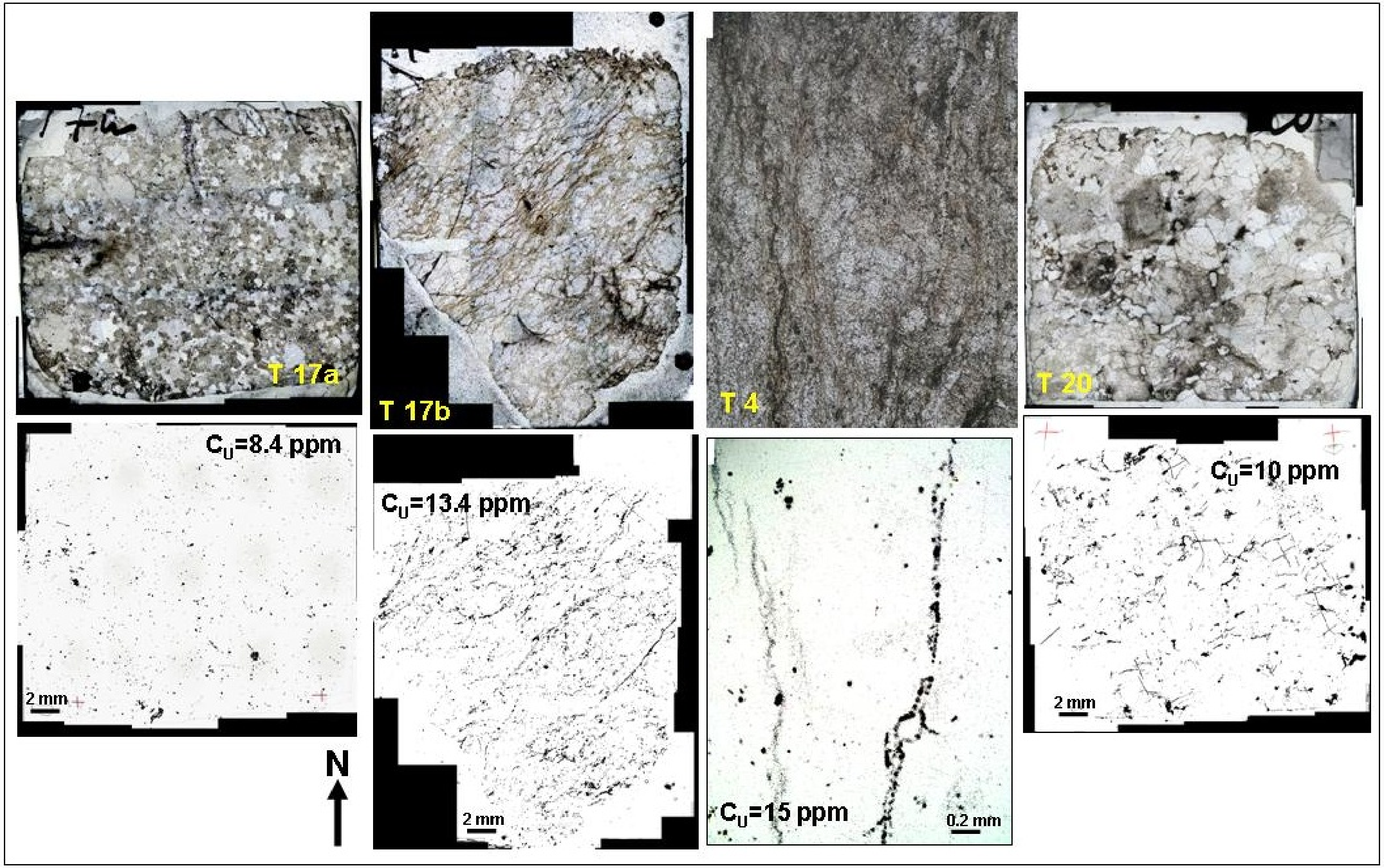


Cretaceous A-type granites: anorogenic (rifting) setting – Kukulbeyskiy (Li-F) complex

T3-J1 A-type granites: postorogenic setting – Shakhtaminskiy complex (?)

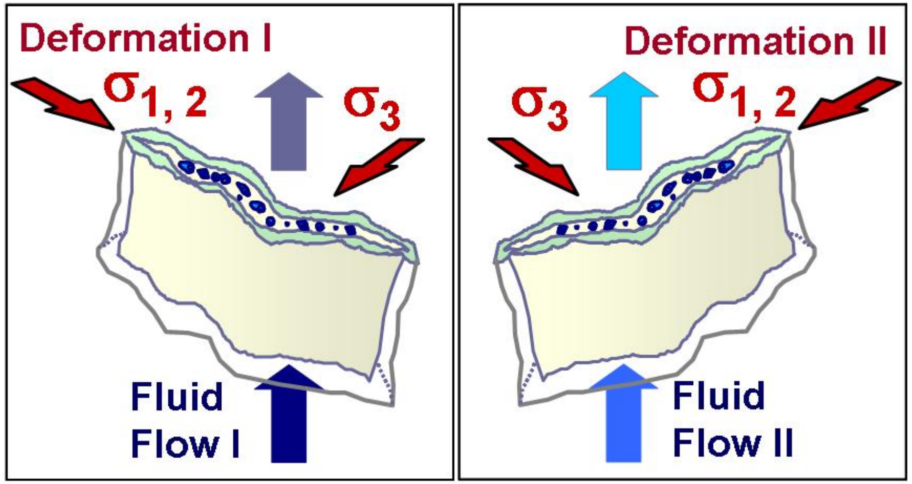
Permian A-type granites: final stages of orogenezis – Undinskiy complex (caldera basement)

Uranium distribution patterns for variously deformed granitic rocks



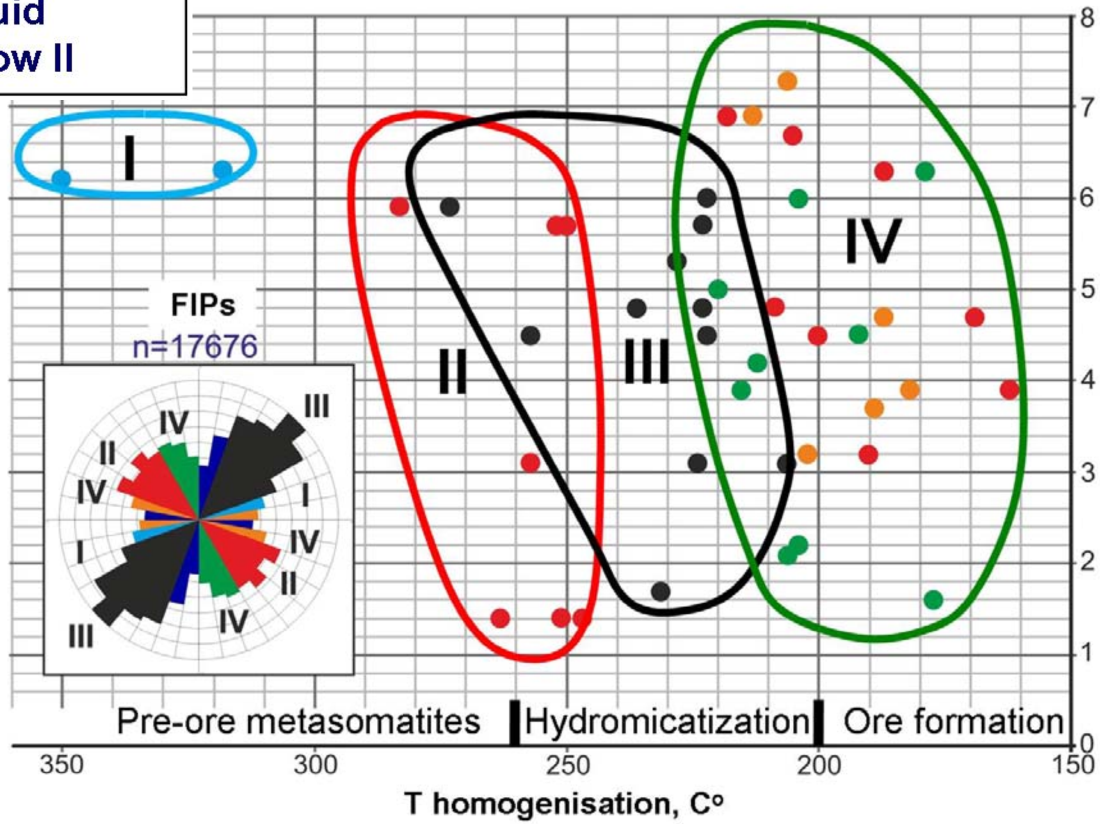
T17a – wall rock of the Urtuy Massif, T17b – NE-SW blastomilonitic zone (ductile deformation) , T4 – Meridional fault (brittle deformation), T20 – fracture network (Fe, Ti and Mn oxyhydroxides). Slices and Fission-Track Radiography - IGEM RAS, uranium content (C_U) - ICP-MS (CRPG, Nancy).

Paleostress regimes and fluidflow dynamics: technique (a) and results (b)

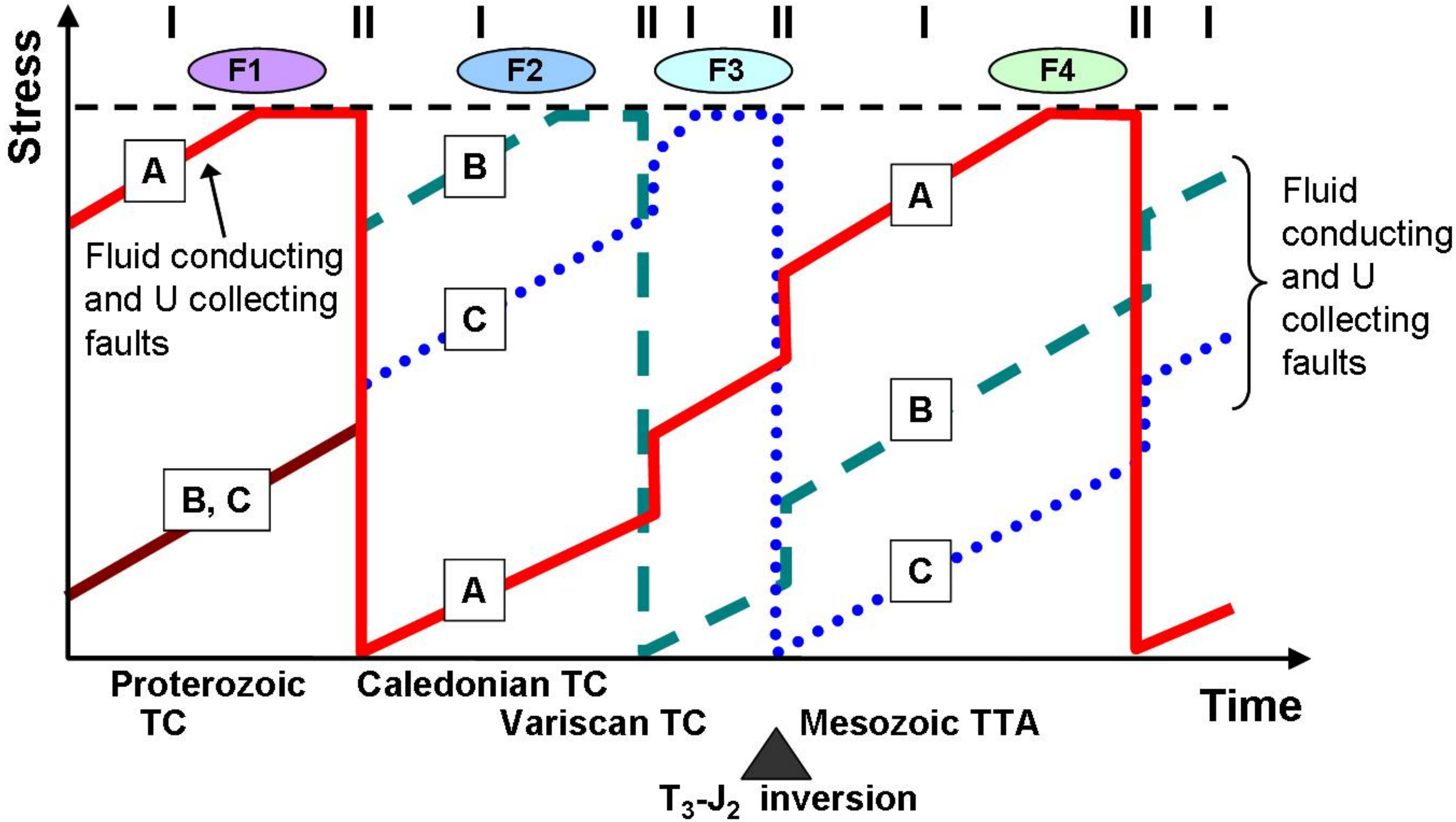


b: Four clusters of FIPs in quartz of the Antey deposit due to their orientation, salinity and temperature of homogenization (Petrov et al., 2013).

a: Dynamics of fluid permeability of the fault zones is reconstructed using spatial distribution and orientation of Fluid Inclusion Planes (Lespinasse et al., 2005; Ustinov, Petrov, 2011) in connection with data on faulting regimes.

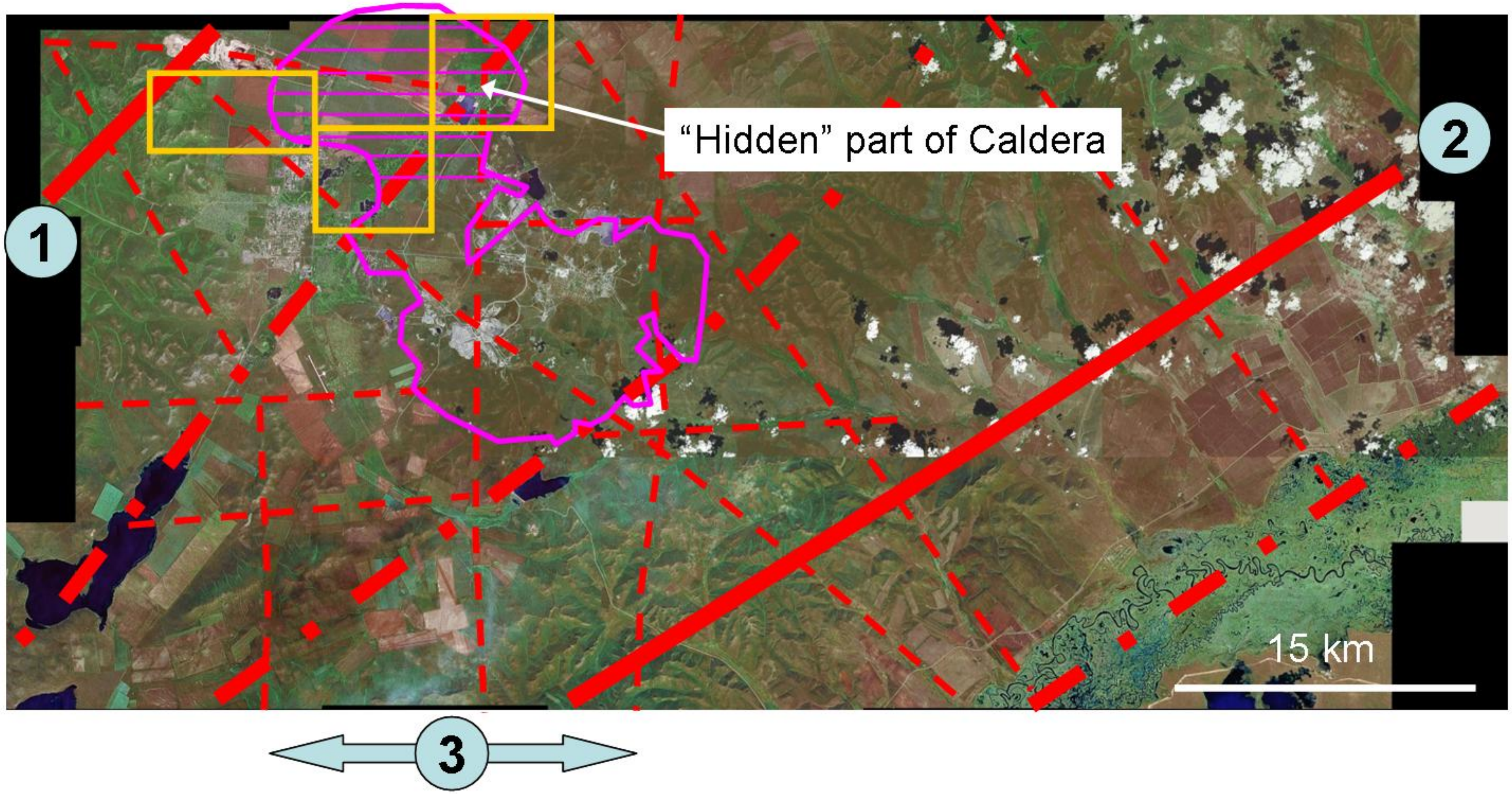


Stress-time dependence of fluid permeability for the fault zones: A – NE-SW, B – NNE-submeridional, C – NW-SE



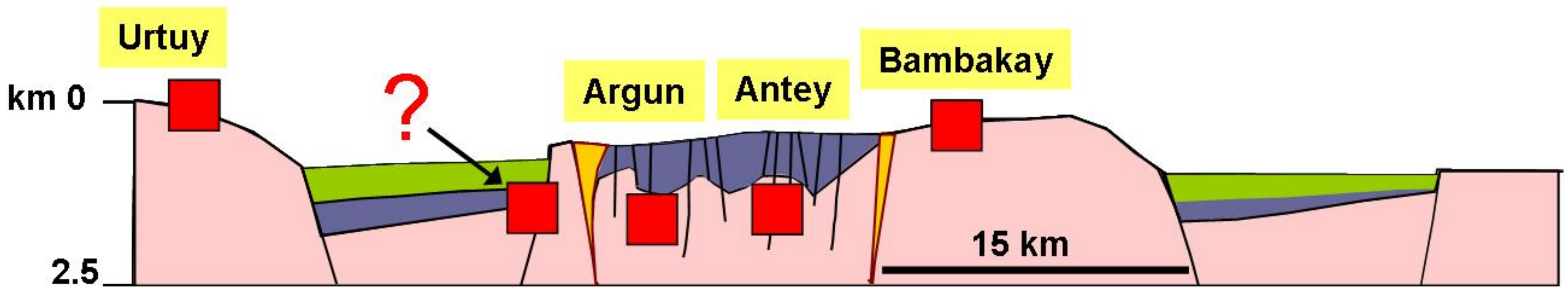
Periods of stress accumulation (I) and relaxation (II) are accompanied by inflow of multiple-aged fluid portions committed to fluid inclusion generations (from 1 to 4) during various tectonomagmatic cycles (TC) and regional tectonothermal activation (TTA).

Satellite view of the Area with the main faults and caldera edge, and sites for further prospecting activity



Main Fault Zones: 1- East Urulunguy, 2- South Argun, 3- Dalaynor-Gazimur

CONCLUSIONS and CHALLENGES



1. CALDERA GRANITIC FRAME: Urtuy and Bambakay Massifs
- AR-PR 800 Ma (relics?) granite-gneiss and PZ1 520 Ma (Caledonian) granites
- NE-SW main fluid conducting faults
- Uraninite formation 770±35 Ma and transformation 195±79 Ma (U-Pb)

2. CALDERA BASEMENT U Deposits:
- AR-PR 800 Ma (relics) granite-gneiss (Argun deposit)
- PZ2 240 Ma (Variscian) granites (Antey deposit)
- NNE-submeridional main fluid conducting faults
- Hydromicatization 131-139 Ma
- U (economic) ores formation 133-135 Ma

3. Long-term fluid circulation in the ore-forming fluid-magmatic system:
- Chronology
- Depth (source and PT conditions)
- Pathways
- Transport mechanisms
- Stress-strain-temperature field evolution