The Genesis of Kurišková U-Mo ore deposits

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EUROPEAN URANIUM RESOURCES LTD.

FACULTAS RERUM NATURALIUM UNIVERSITAS MATTHIAE BELII

ŠTÁTNY GEOLOGICKÝ ÚSTAV DIONÝZA ŠTÚRA
MENTE ET MALLEO

Geologický ústav
Slovenská akadémia vied

Kurišková project development

- Uranium (uranium ore) has higher value in comparison with coal
- Nuclear Energy is important for Slovakia
- Kuriškova is a deposit in exploration –development stage with highest uranium grade in the Europe , and one of the best in the world. The deposit contains another strategic product , molybdenum.
- Kuriškova deposit can be a secure energy source for Slovakia for tens of years and will bring stability and development of nuclear energy in the terms of approved 2008 Energy policy for Slovakia.
- Deposit contains approximately 15 thousand tons of uranium , this amount represents 50 years Slovakia consumption. (Slovakia needs 300 t U/year). Deposit has potential to grow with ongoing exploration.
- Slovakia can be back on a Energy map of Europe; not only as 100 % independent state but as an active contributor to Energy system of EU.

Resources of Kurišková U-Mo deposit were tripled during modern EUU exploration

NI 43 -101 compliant Resources Kuriskova Uranium Projects, April, 2011

Resources	Ore	Grade		Metal in t		Metal in k lb	
	k t	%U	%U308	U	U308	U	U308
Indicated	2 328	0,471	0,555	10 957	12 921	24 157	28 487
Inferred	3 099	0,157	0,185	4 871	5 744	10 739	12 664
Total	5 427			15 829	18 666	34 896	41 151

Resources	Ore	Grade	Metal in t	Metal in k lb
	k t	%Mo	Mo	Mo
Indicated	2 301	0,065	1 502	3 312
Inferred	2 996	0,033	991	2 185
Total	5 297		2 493	5 497

Resources	Block N.	Ore in t	Average grade		
			U(%)	Mo(%)	Cu(%)
Inferred	J-1-Z-3	1 396 000	0,472	0,380	0,15

Výpočet zásob Daniel, Uranpres s.r.o. v r.2005

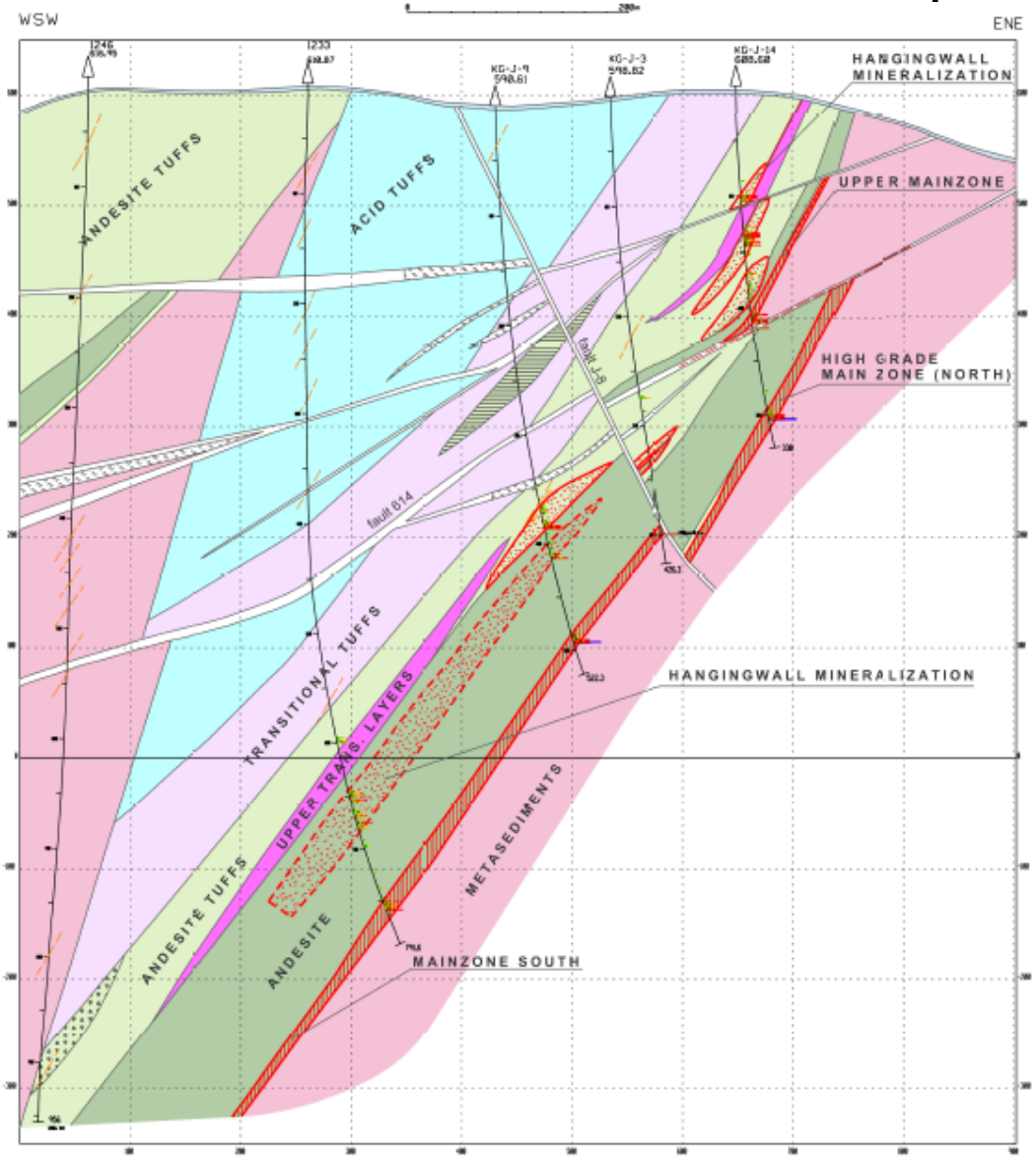
THE MAIN TOPICS OF PRESENTATION:

- location of U-Mo Kurišková deposits
- Lithological and stratigraphical characterization of host rock complex
- Metamorphism and alteration overprint / ore formation
- Tectonic deformation of host rock complex
- Position of ore precipitation
- Characteristic of U-Mo mineralization
- Geochemistry of U-Mo ore
- Geochronology of ore forming processes
- Model of petrogenetic processes resulted U-Mo ore formation

General Location Map of the Kuriskova U-Mo deposit

General cross section of the Kurišková deposit

- Underground resources of high grade ore
- Potential of deposit open to the depth and to the strike
- Preliminary Assessment June , 2009
- Update of resource calculation , March 2011
- Prefeasibility study , March 2012
- 27 old holes
- 124 new holes
- 56,000 m of the drill core



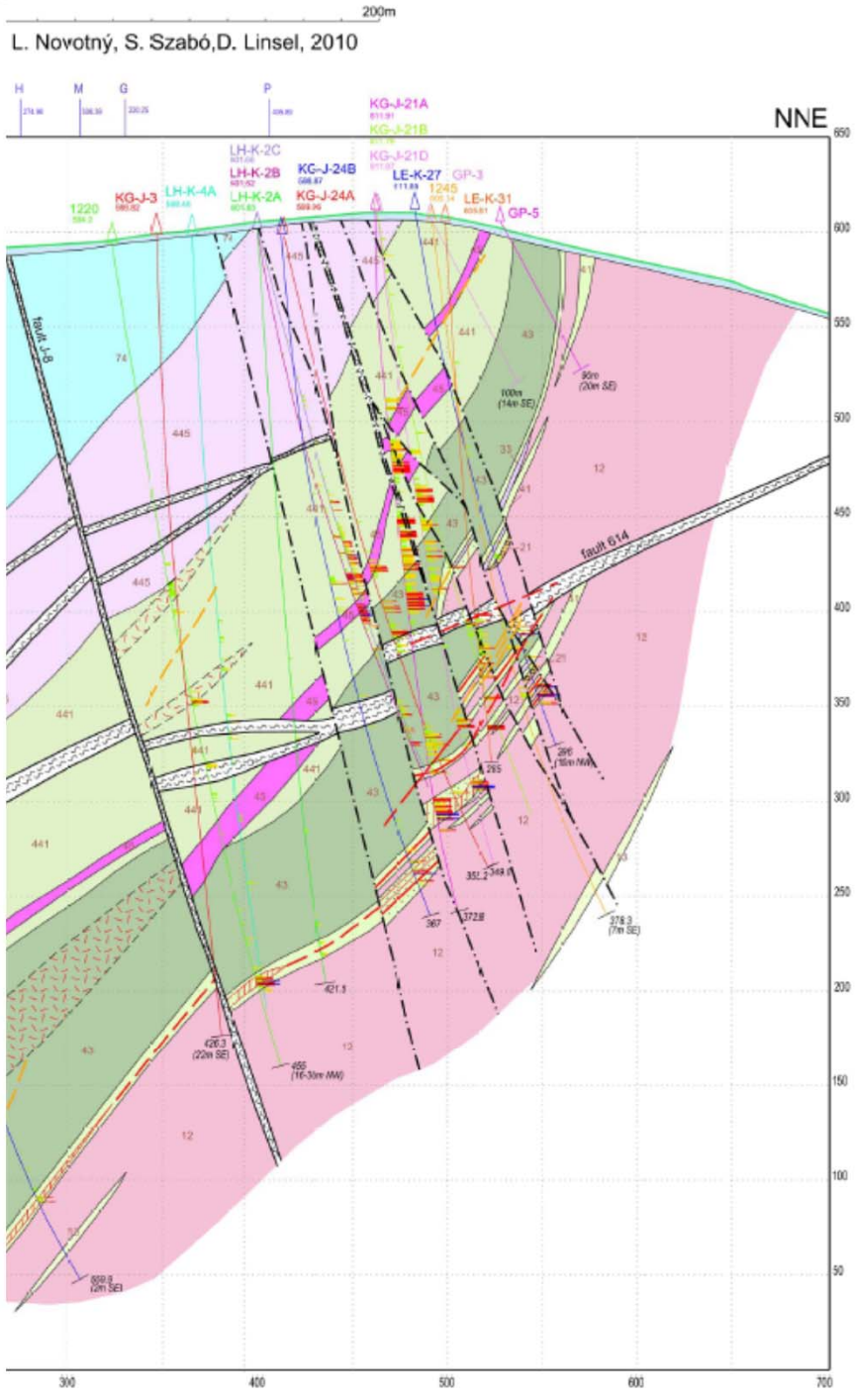
LITOSTRATIGRAPHIC SCHEME OF NORTHERN GEMERICUM PERMIAN IN KURISKOVA AREA

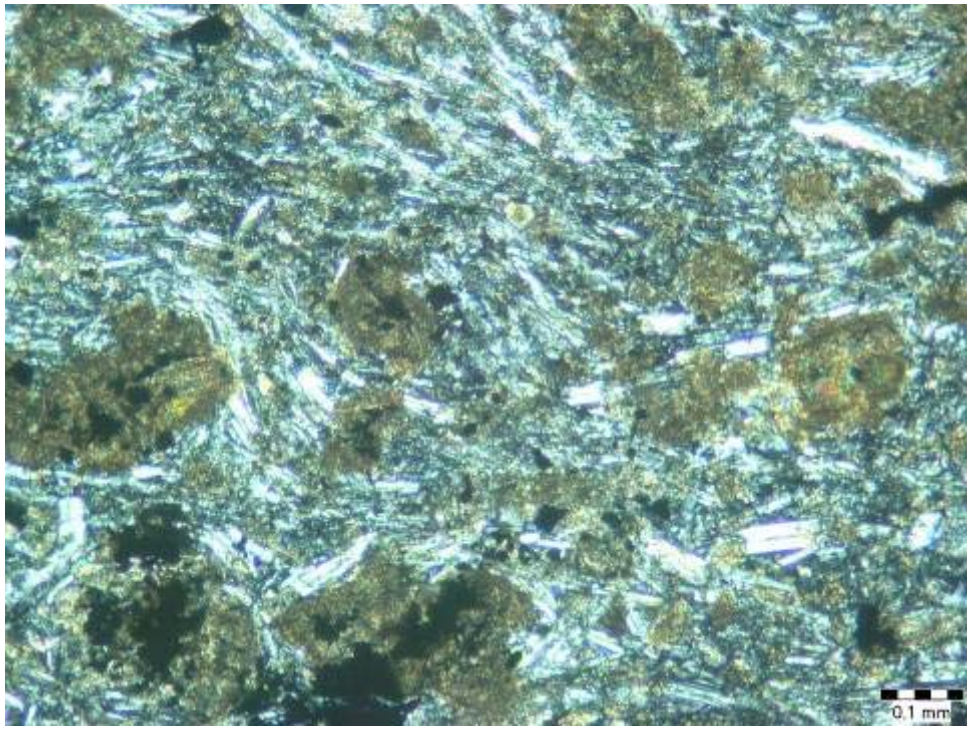
Zostavili: L. Novotný, S. Szabó, 2008
s použitím údajov F. Miháľa, 1990

útvar *System Period*	oddelenie *Series Epoch*	stupeň *Stage Age*	súvrstvie *Formation* – názov *Name*	litostrat. index	mocnosť v m *Thickness in meters*	VRSTVY (KOMPLEX) NÁZOV *LAYERS (COMPLEX) NAME*	mocnosť v m *Thickness in meters*	litostrat. index	kód horniny *Rock code*	LITOLÓGIA *LITHOLOGY*	kód horniny *Rock code*	rudná poloha *Ore body*
PERM *PERMIAN*	VRCHNÝ *UPPER*	TURING	Novoveské súvrstvie *Novoveska Huta formation*	P_2	350 - 500	bielovodské vrstvy *Bielovodske layers*	200-300	$^{pb}P_2^b$	113			
								$^{e}P_2^b$	112 111			
						stražanské vrstvy *Strazanske layers*	150-200	$^{pb}P_2^a$	103			
								$^{p}P_2^a$	102			
						stražanské zlepence *Strazanske Conglomerates*		$^{k}P_2^a$	101			
	SPODNÝ *LOWER*	SAXON	Petrovohorské súvrstvie *Petrova hora formation*	P_1^2	450 - 800	malomuránske vrstvy *Malomuranske layers*	50	$^{pb}P_1^i$	91			
						grúnsky vulkanicko-sedimentárny komplex *Volcanic-sedimentary complex of Grun*	> 200	$_{at}\lambda'P_1^g$	72			
								$_{t}\lambda'P_1^g$	74			
						hutniansky vulkanicko-sedimentárny komplex *Volcanic-sedimentary complex of Novoveska Huta* – prechodné tufogénne vrstvy *tuffogenic transitional layers*	40-150	$_{pt}\zeta'P_1^d$	445			
						nadložné tufogénne vrstvy *tuffogenic hanging-wall layers*	30-120	$_{4}\zeta'P_1^d$	444		442	
								$_{1t}\zeta'P_1^d$	441			
							0 - 70	$_{3}\zeta'P_1^d$	443			3.p 3rd ore body
							0 - 20	$^{b}P_1^d$	45			
								$_{1t}\zeta'P_1^d$	441			2.p 2nd ore body
						bazaltoidné andezity, bazalty *basaltoid andesites, basalts*	20-100	$\zeta'P_1^d$	43			2.p 2nd ore body
						podložné tufogéne vrstvy *tuffogenic footwal layers*	2 - 10	$_{1t}\zeta'P_1^d$	41		41	1.p 1st ore body
						spodné prechodné vrstvy *Lower transitional layers*	0 - 6	$^{b}P_1^c$	33		33	
							0 - 5	$^{pb}P_1^c$	31		31	0.p 0 ore body
						čiernohorské zlepence *Cierna hora Conglomerates*	0 - 1	$^{k}P_1^c$	21		21	
		AUTUN	Knolské súvrstvie *Knola formation*	P_1^1	> 200	markušovské pieskovce, aleurolity *Markusovske sandstones, aleurolites*	> 100	$^{bp}P_1^b$	12 13 12			

KOSICE I. - JAHODNA

L. Novotný, S. Szabó,D. Linsel, 2010





Petrography of basalte volcanics

Textures : porphyric, hyalopilitic, trachytic

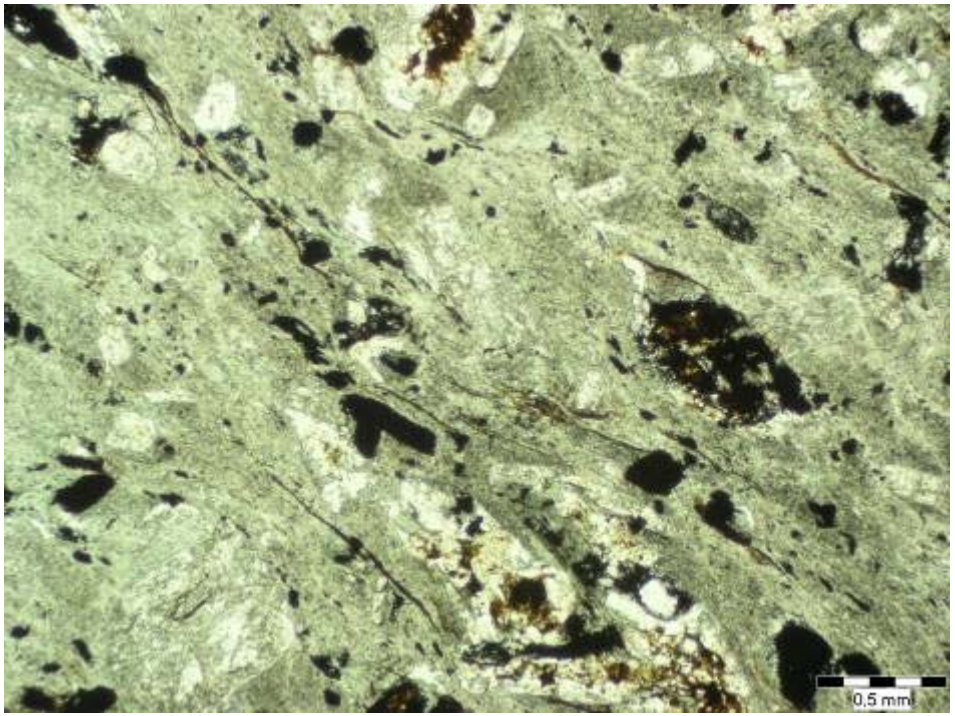
Phenocryste association: Cpx + Pl + Ilm + Ol? + Amf?

Alteration: extensive chloritization and carbonation

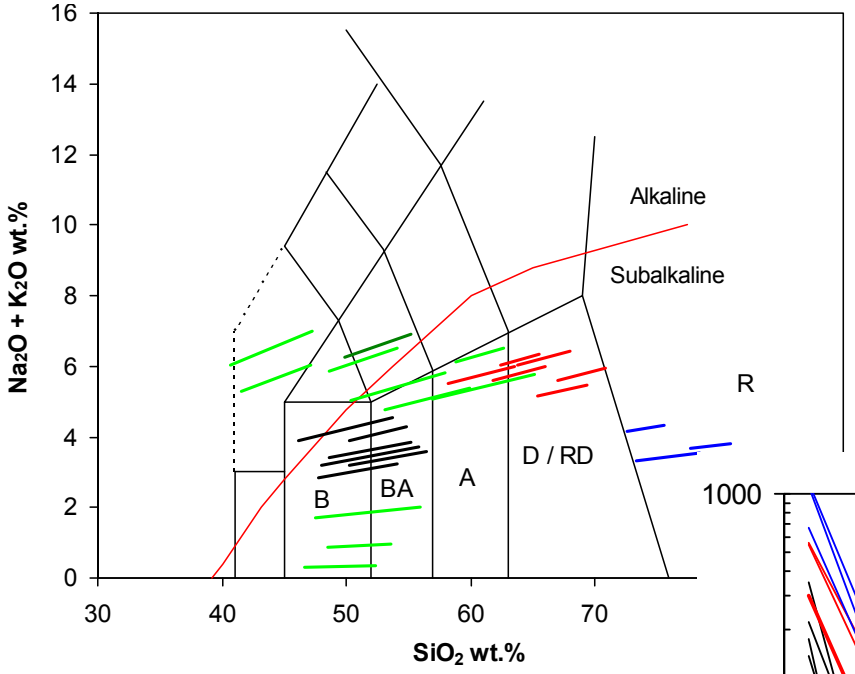
Petrography of acid volcanic rocks

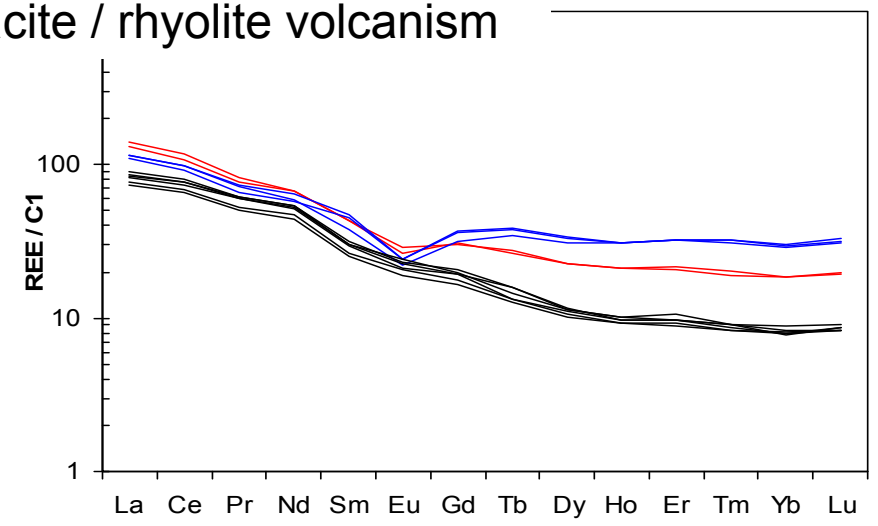
Peraluminious dacites and rhyolites:

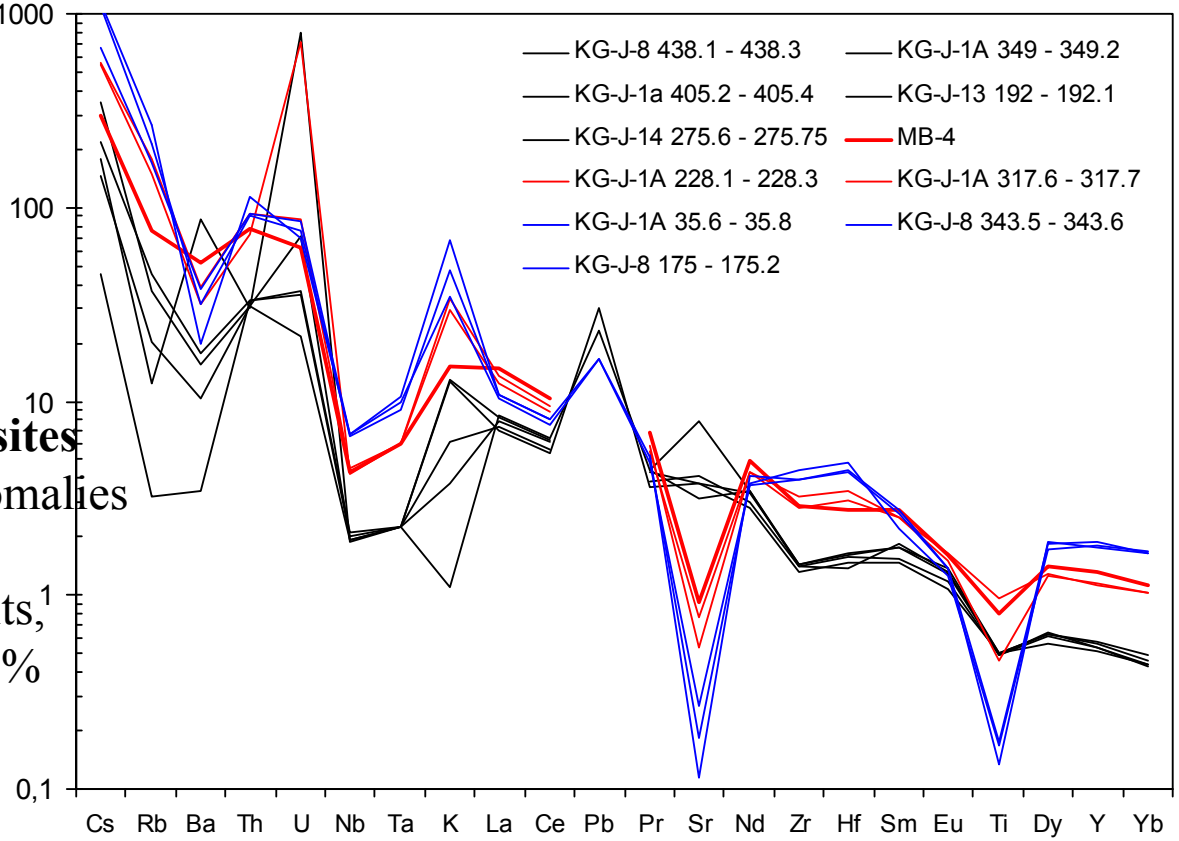
Textures: porphyric to glomeroporphyric with glassy or hyaline matrix
Phenocryste association: Qtz – Pl – Kfs – Bt - Amf



Geochemical character of bimodal basalt – dacite / rhyolite volcanism



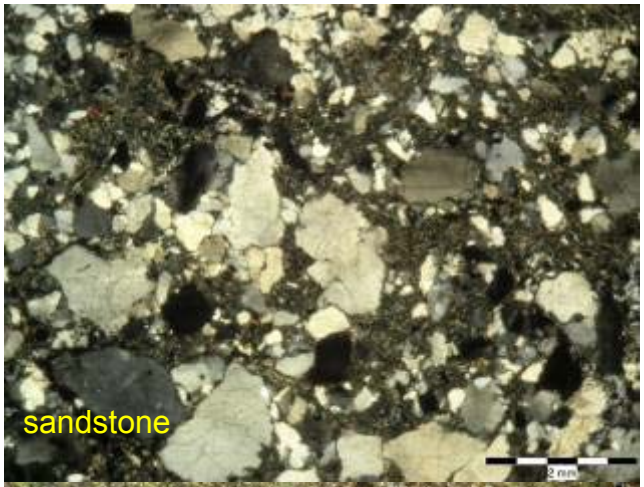


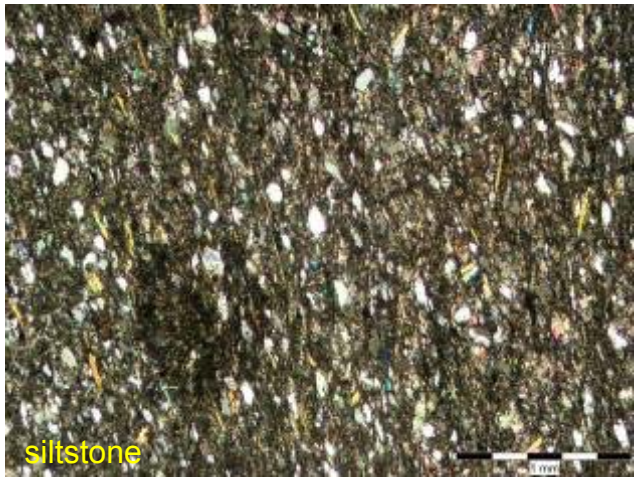


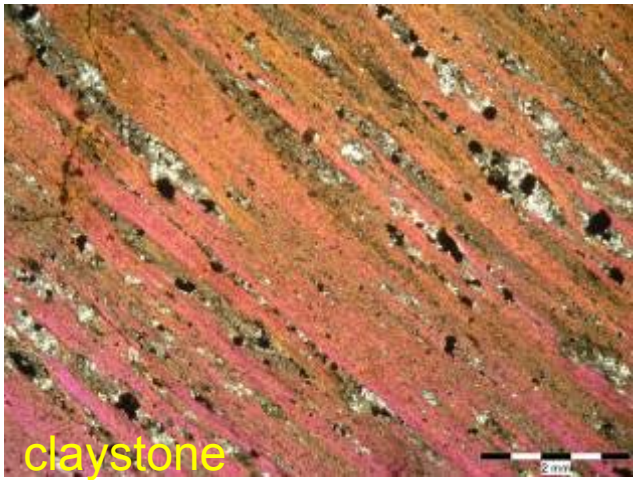
Subalkaline basalt to basaltic andesites
High MgO 8,8-10 wt.%; none Eu anomalies
Ni >200 ppm, Cr > 400ppm ⇒
primitive undifferentiated mantle melts,
similar to boninites 0,2 % TiO_2 < 0,7 %

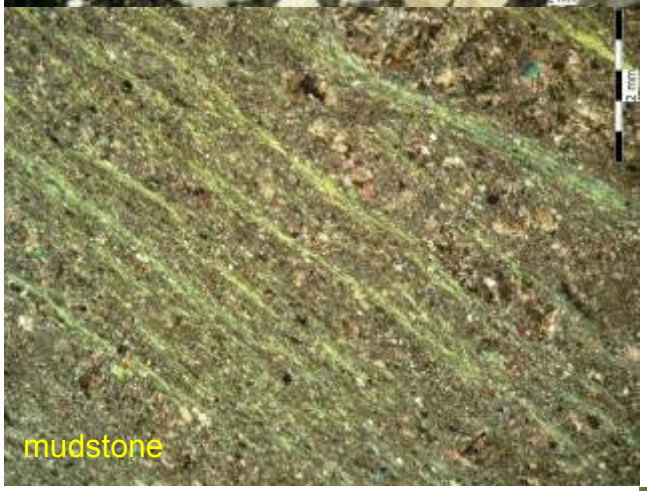
Peraluminious rhyolites
of High-K magmatic series

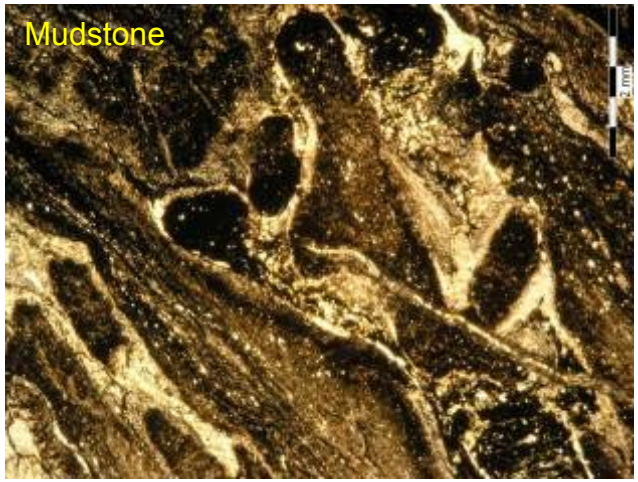

greywacke


sandstone

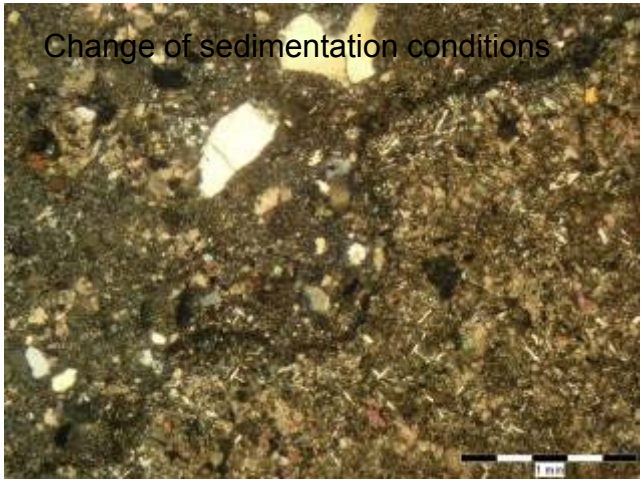

siltstone

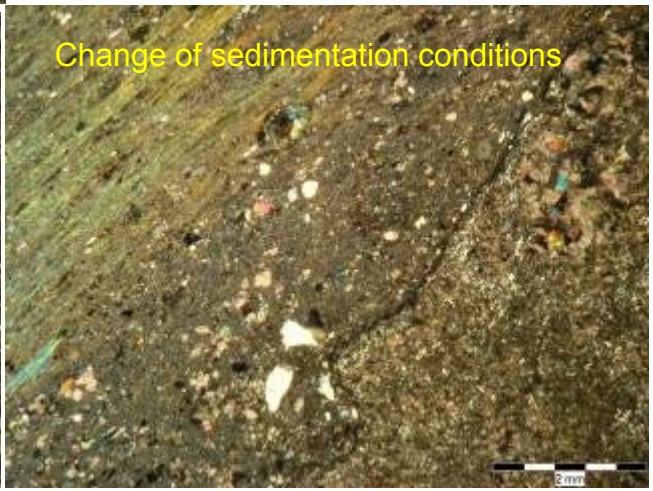

claystone


mudstone

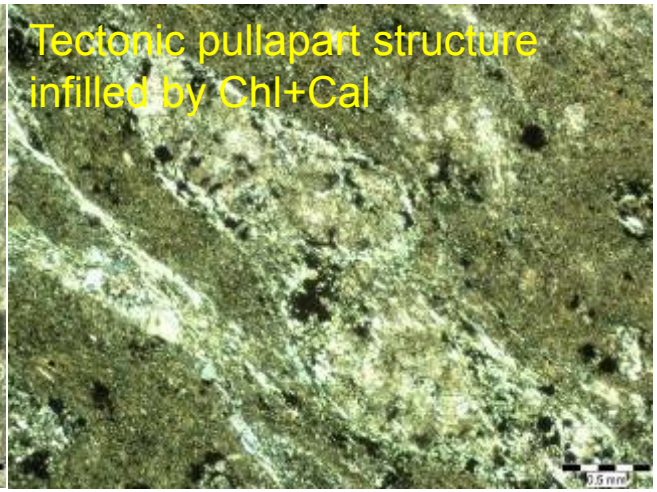

Mudstone

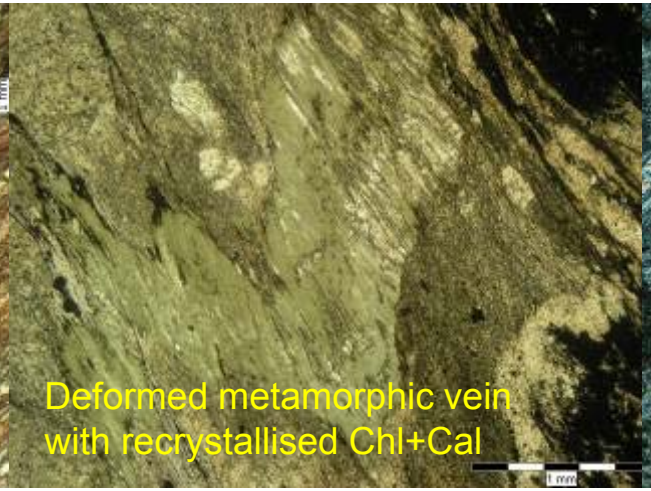

Change of sedimentation conditions,
slightly deformed

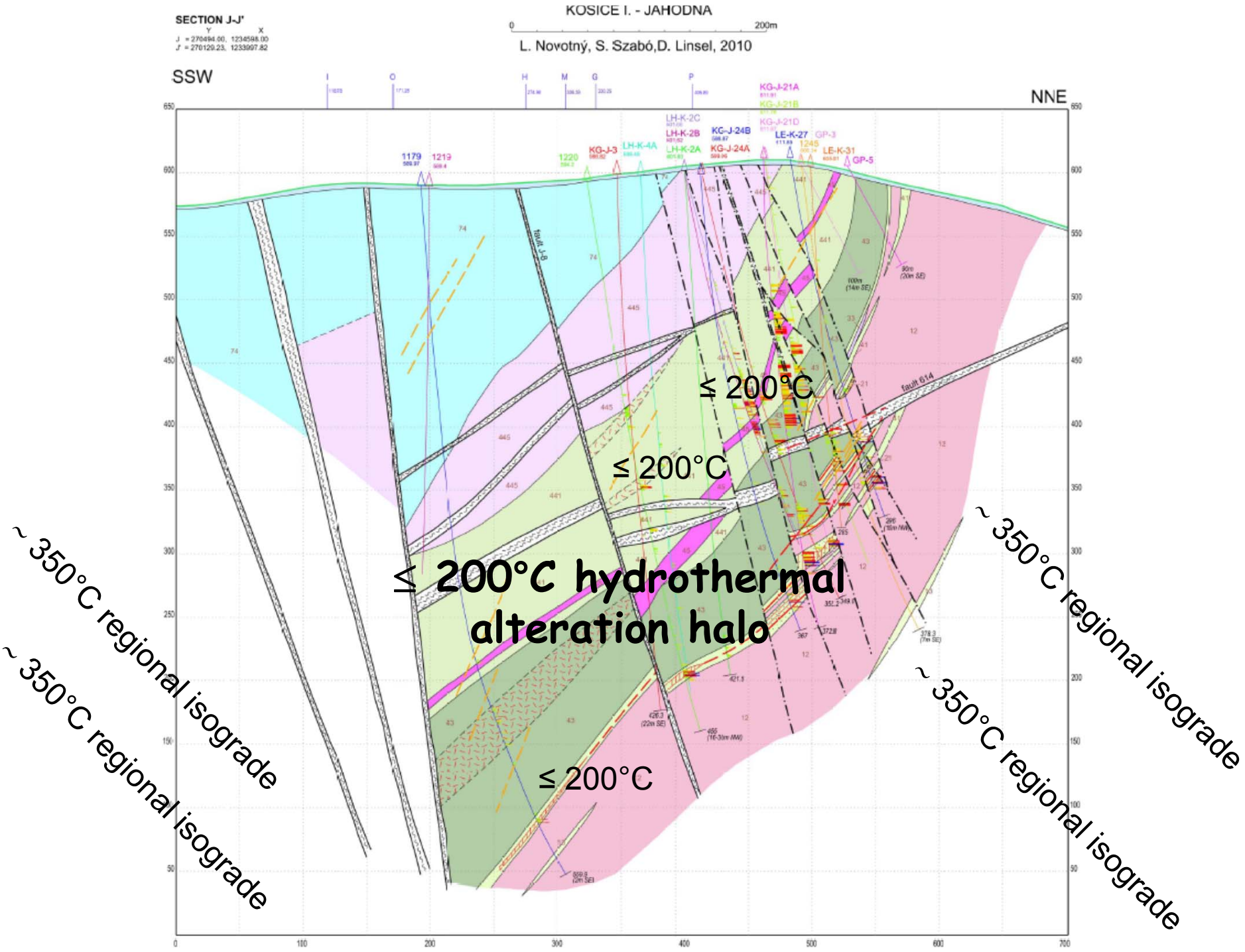

Change of sedimentation conditions


Change of sedimentation conditions

Petrographycal overview of deformation structures recorded in host rock complex






SECTION J-J'
KOSICE I. - JAHODNA
0
200m
L. Novotný, S. Szabó,D. Linsel, 2010
SSW
NNE
≤ 200°C
≤ 200°C
≤ 200°C hydrothermal alteration halo
≤ 200°C
~ 350°C regional isograde
~ 350°C regional isograde
~ 350°C regional isograde
~ 350°C regional isograde
fault J-8
fault 614

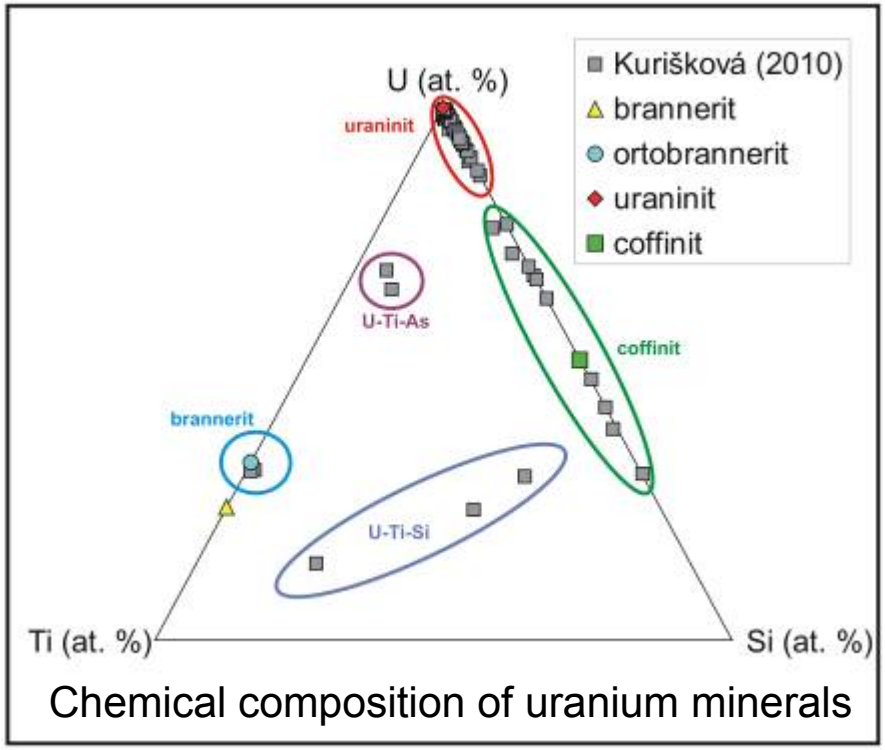
Mineralogical composition of Kurišková U-Mo deposit

Principal U-Mo ore forming minerals: uraninite, coffinite, molybdenite with accessory U-Ti-As, U-Ti-As and brannerite

Sulphidic minerals: pyrite, Cu-Pb-Sb suphosalt, tetraedrite, tennantite, chalkopyrite, galenite, gersdorffite, enargite, bornite, chalkozine, roxbyite, CuxFeySz, covellite

Gangue minerals: quartz, carbonate, chlorite, apatite

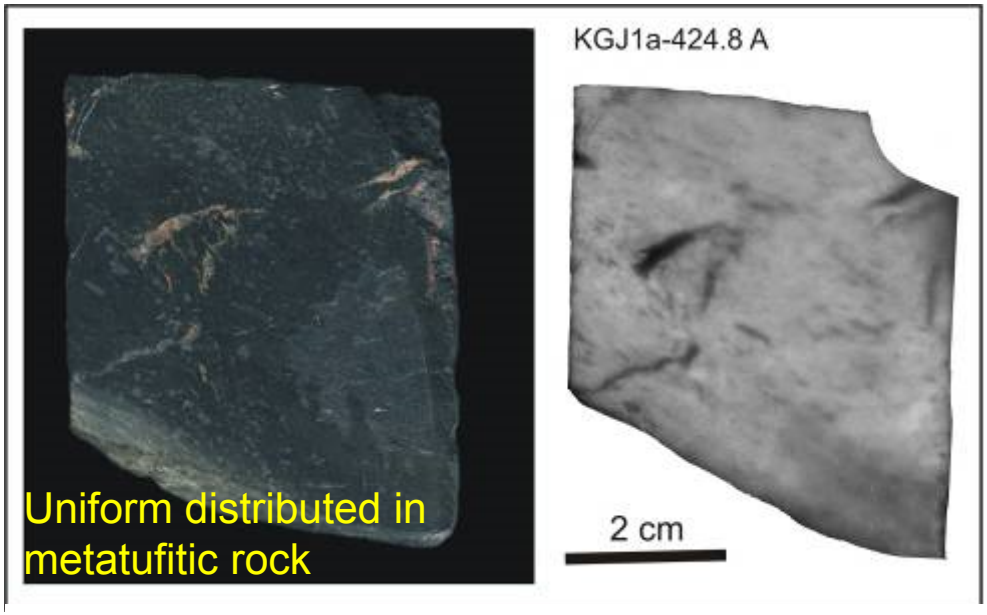
There are not principal mineralogical differences between a different deposit layers, except for a small volume of brannerite occurrence in host metabasalt

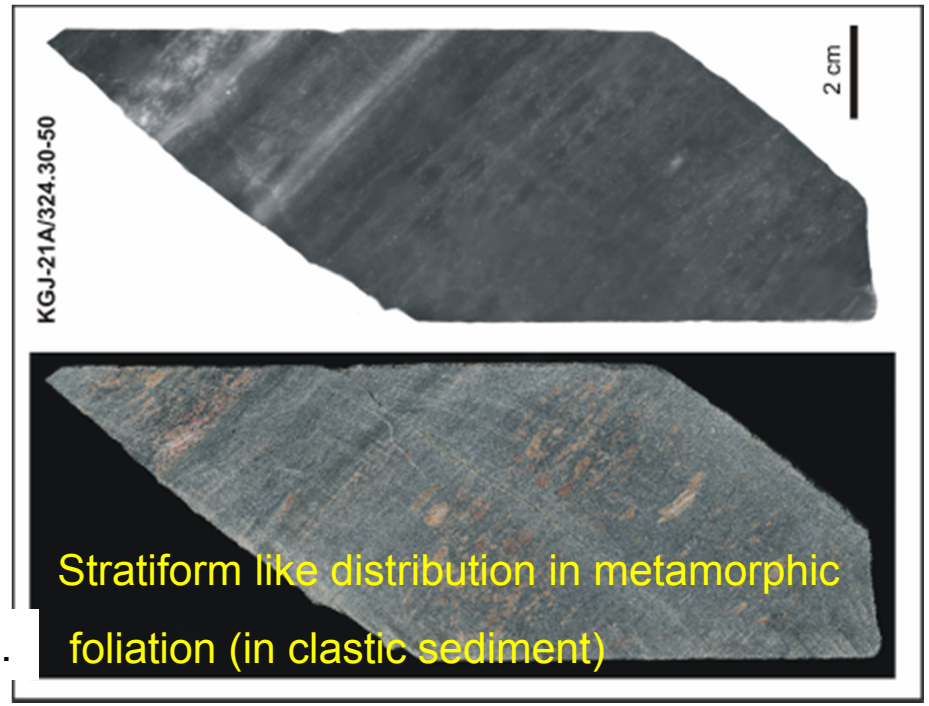


Chemical composition of uranium minerals

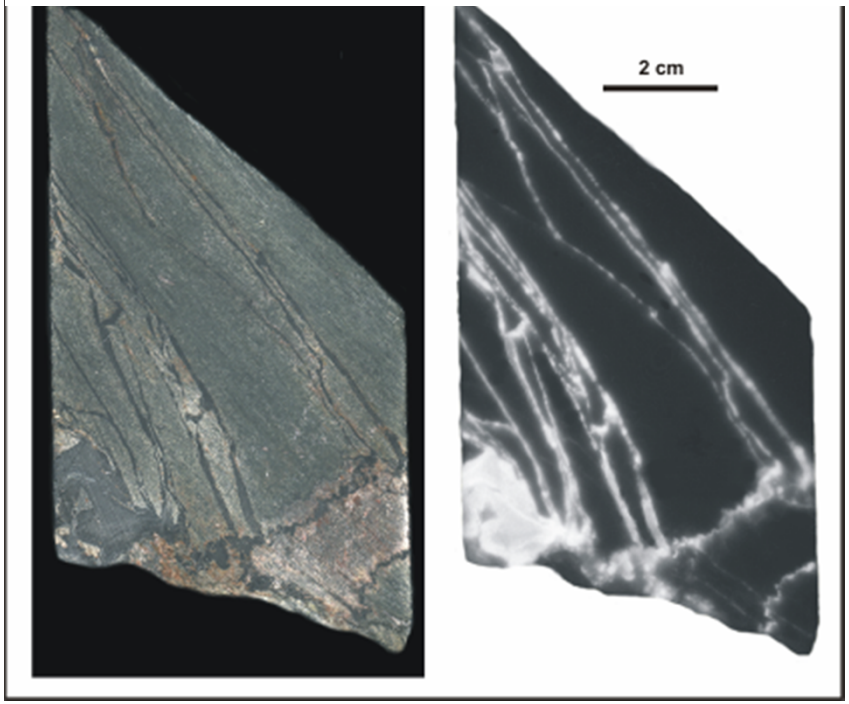
Š.Ferenc et al., 2007, 2008, 2010

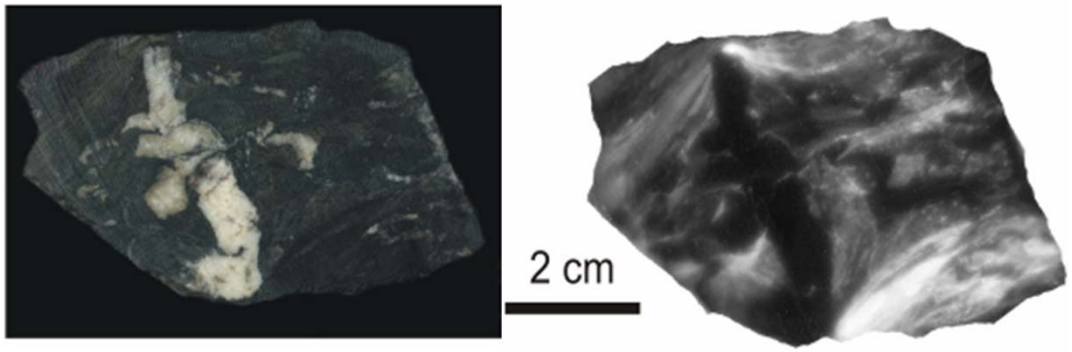
Radiograms showing different type of uranium distribution in host rocks, tectonic relation





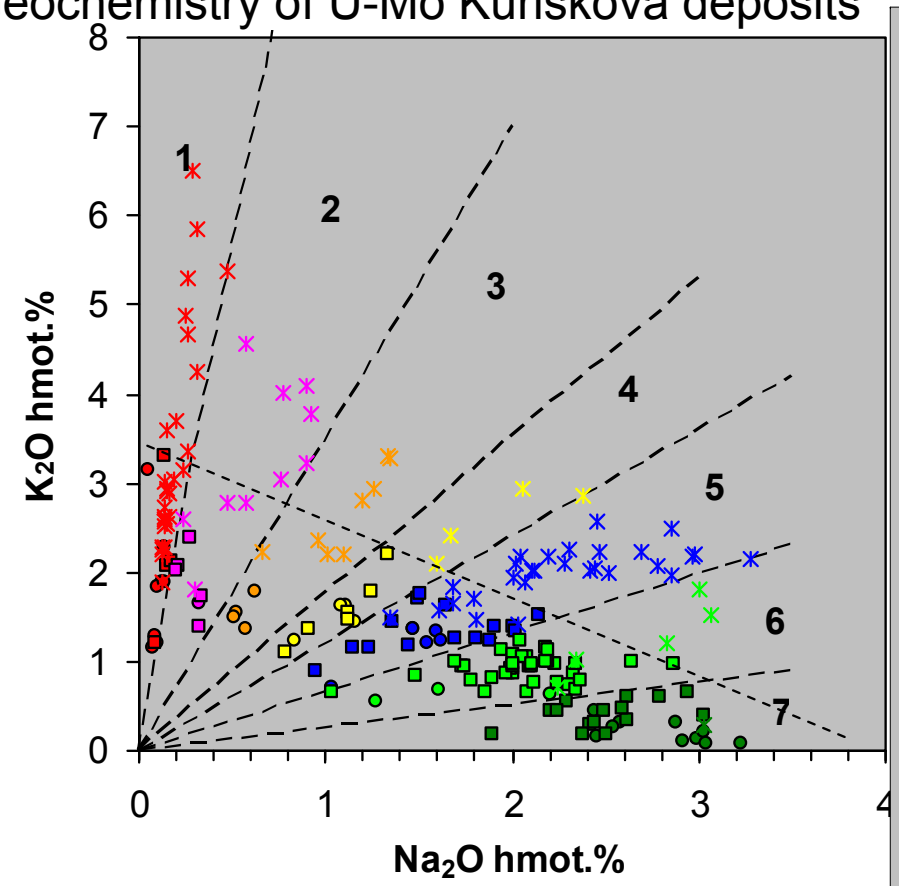
Vein mineralization infilling brittle deformation zones.

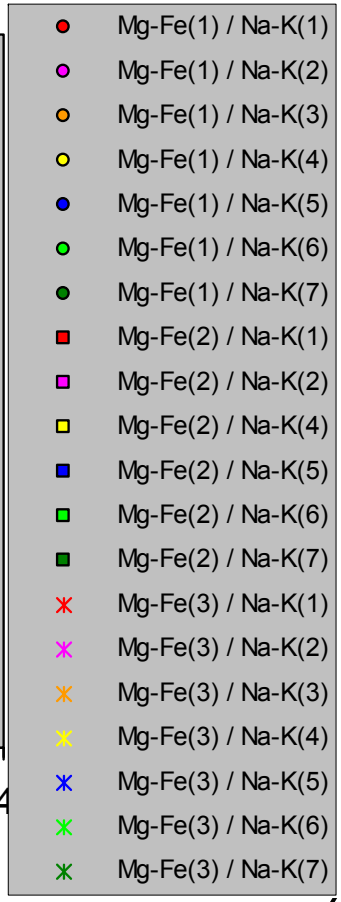


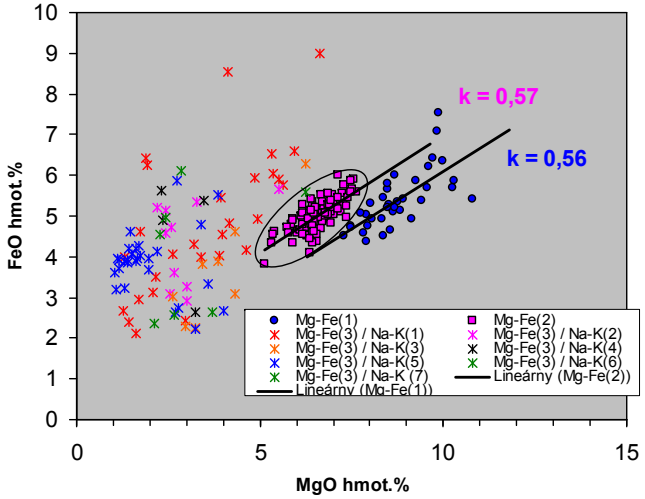


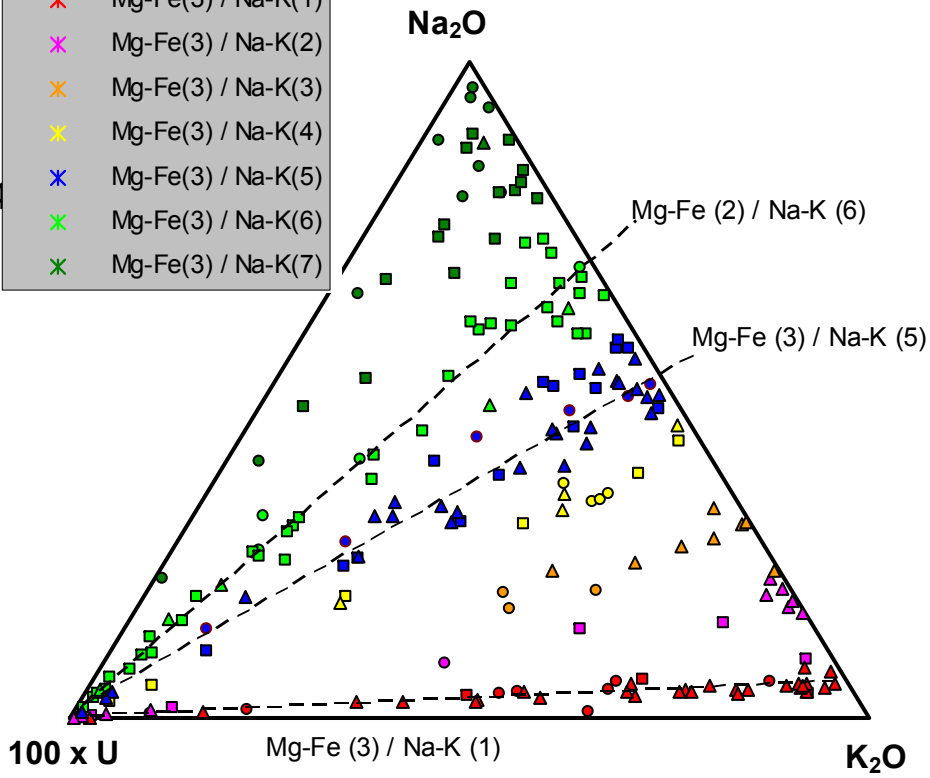
Precipitation and remobilization of U minerals during dynamic deformation of host rock complex

Geochemistry of U-Mo Kurišková deposits







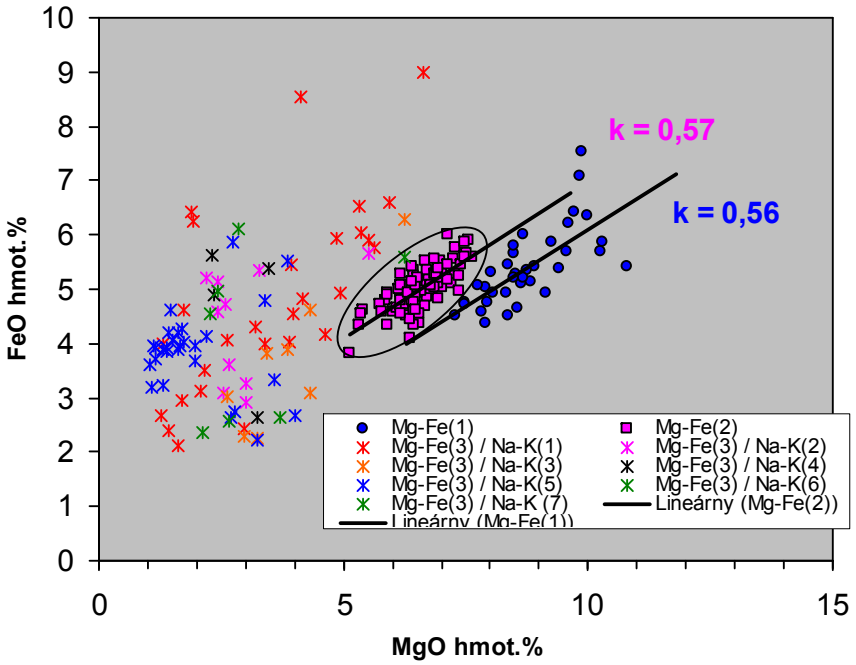


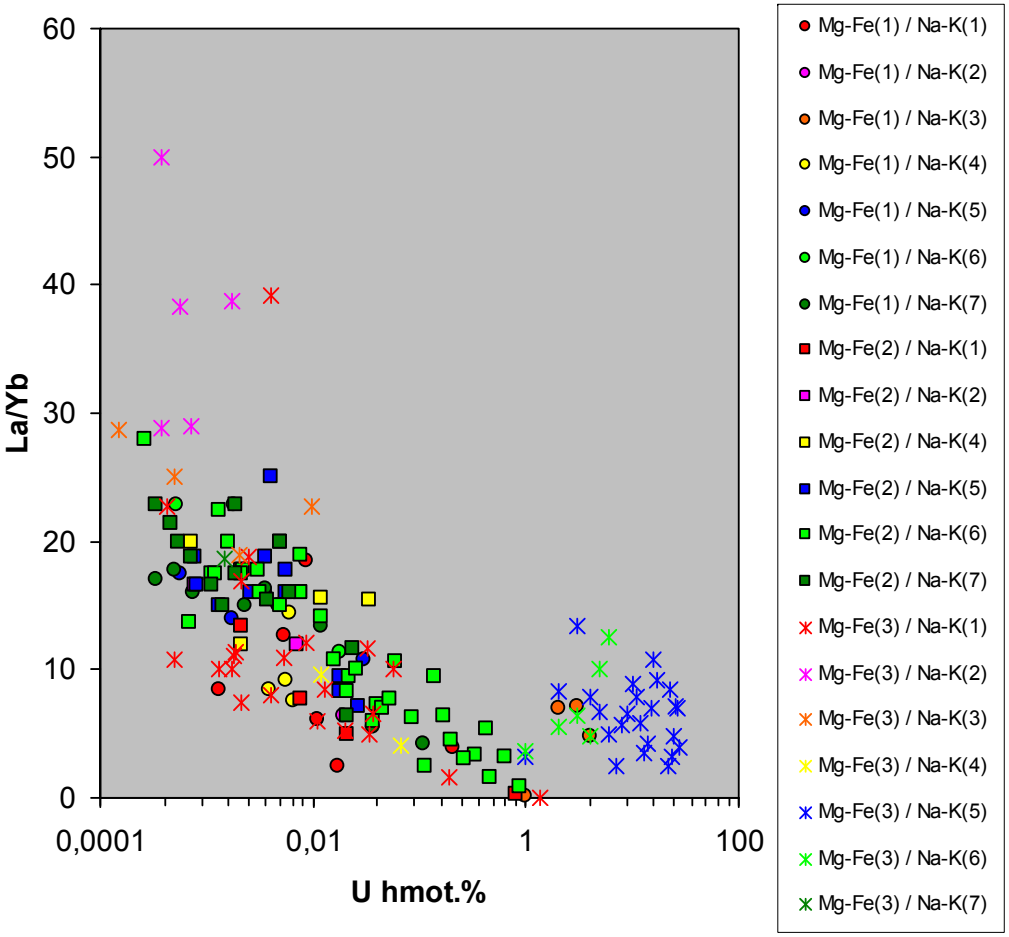
Important geochemical correlation U:

Mg-Fe(1): P(0,91); Pb(0,93); Tb(0,83); Y(0,76); Yb(0,63)

Mg-Fe(2): P(0,94); Pb(0,95); Tb(0,7); Y(0,86); Yb(0,85); Mo(0,61);

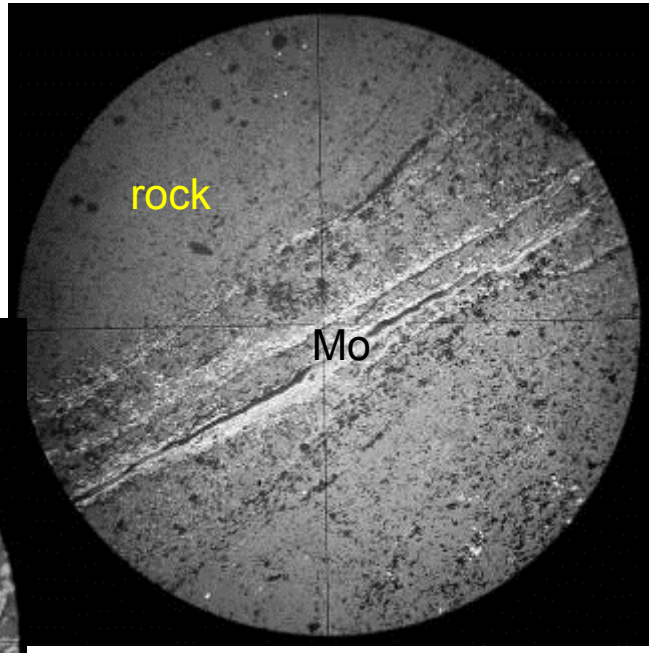
Mg-Fe(3): P(0,53); Pb(0,96); Tb(0,6); Y(0,71); Yb(0,66)

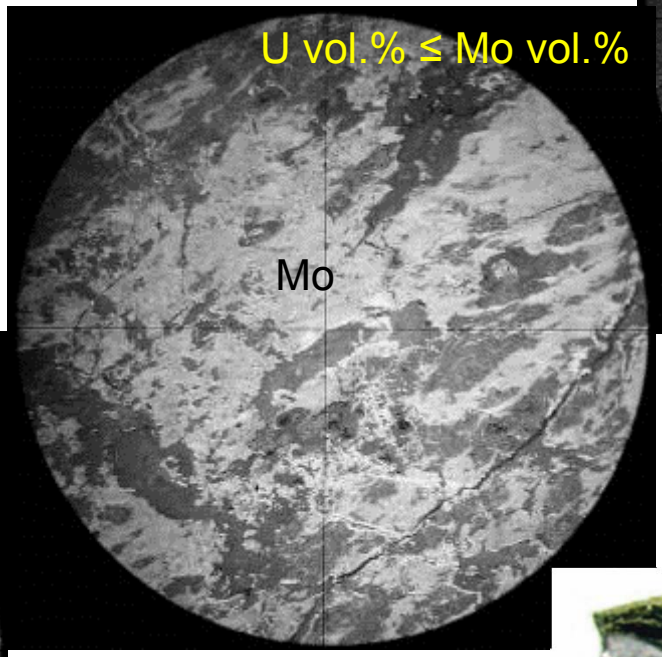


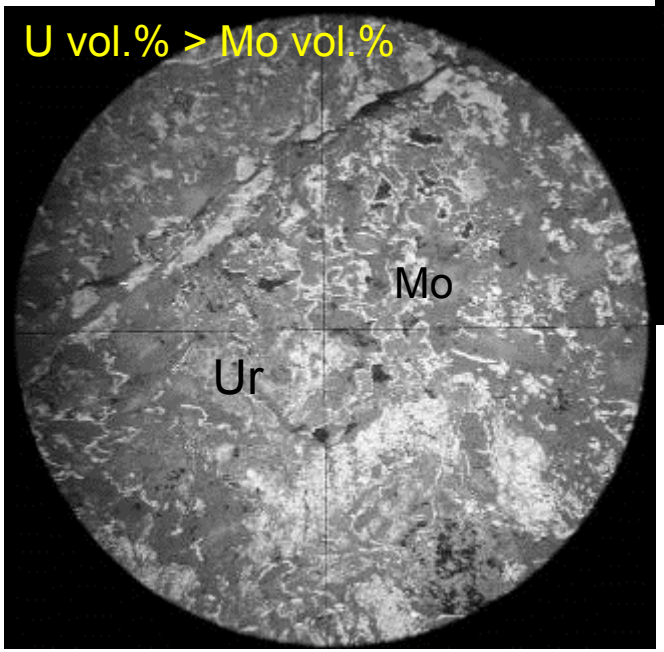


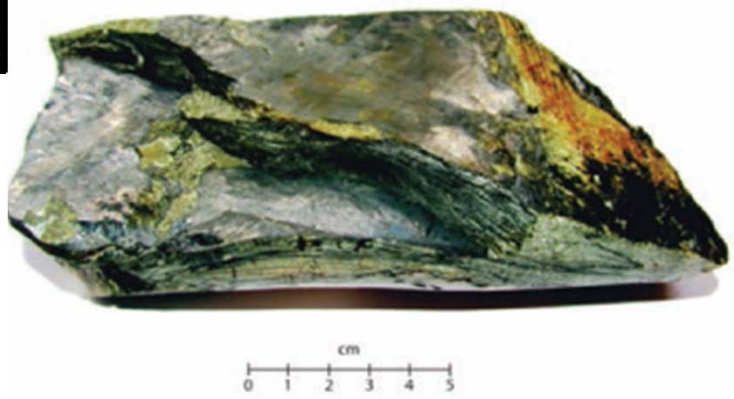
U-Mo compositional variability in Kurišková U-Mo ore deposit

Mg-Fe (1) metatufitic high-Mg group r = 0,31
Mg-Fe (2) metabasalt medium-Mg group r = 0,61
Mg-Fe (3) metasediment low-Mg group r = 0,57

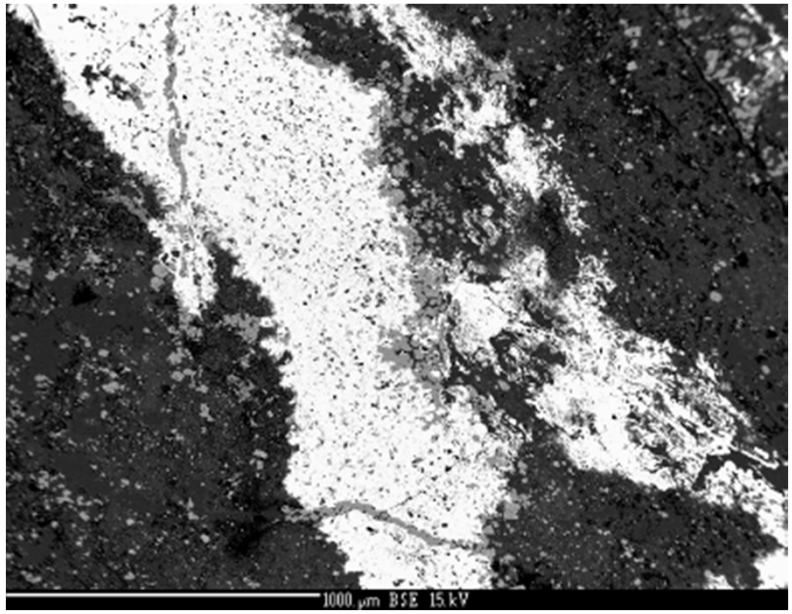


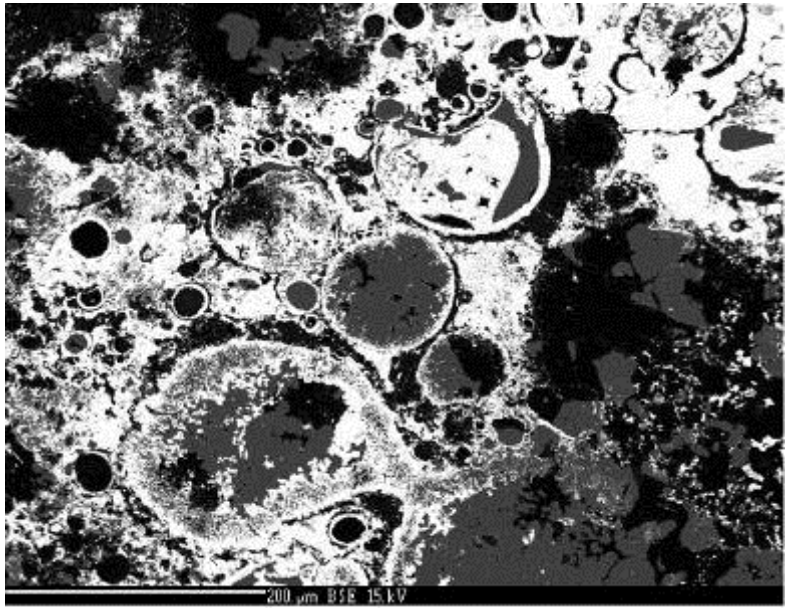


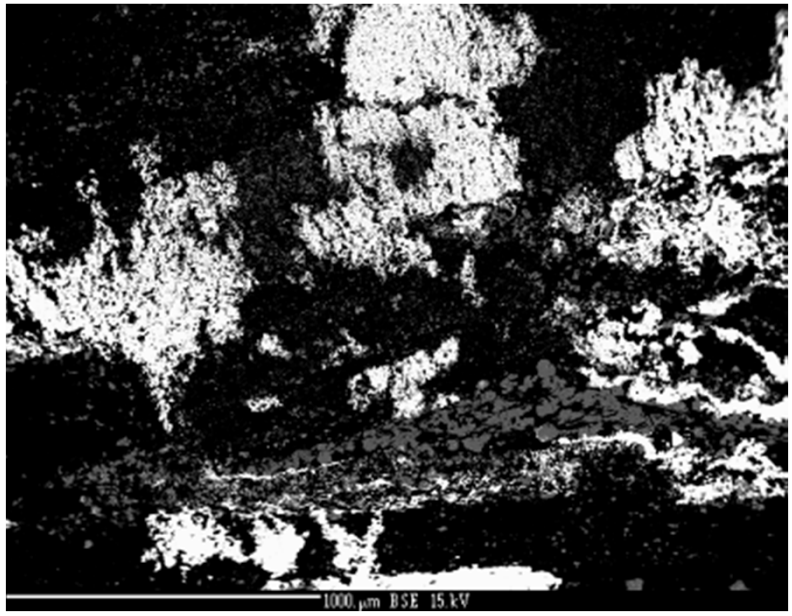


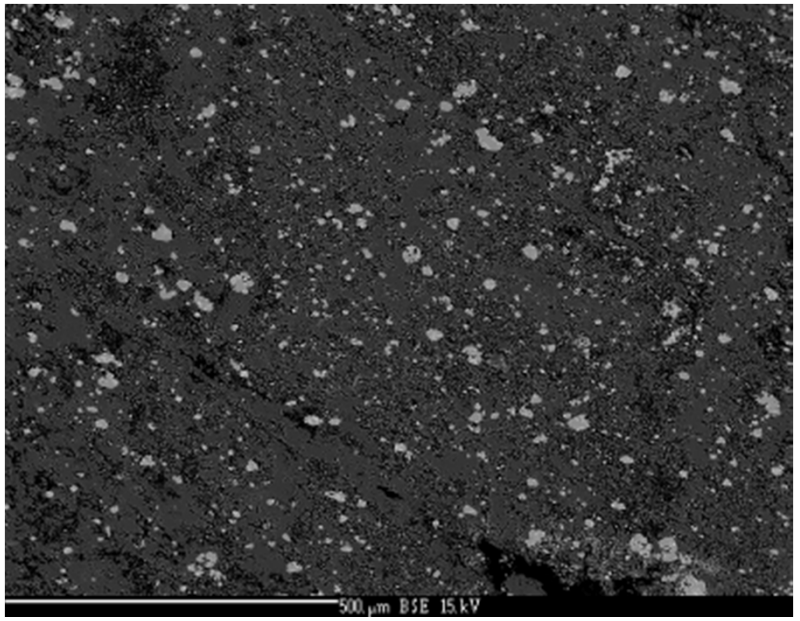


Different relationship between apatite crystals and uraninite-cofinite mineralization







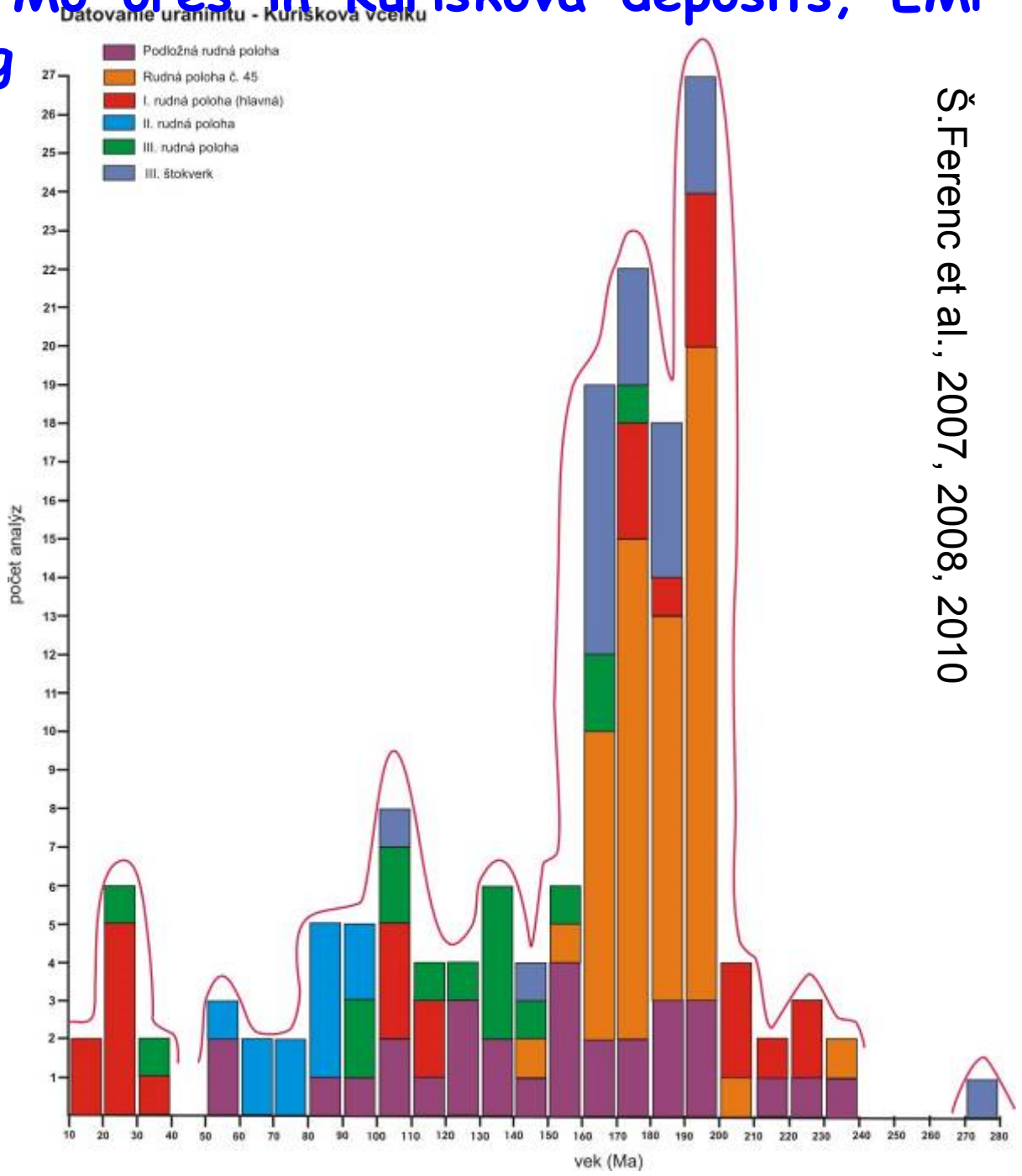


Geochronology of U-Mo ores in Kurišková deposits, EMP U-Pb uraninite dating

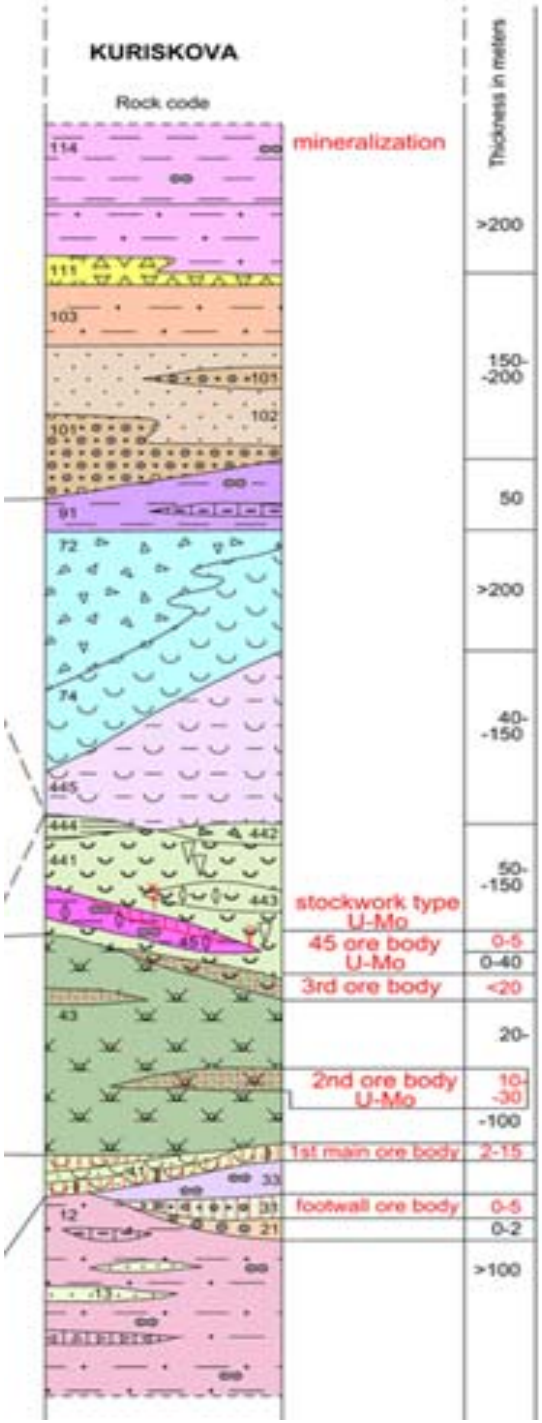
240 – 200 Ma starting of the first ore forming processes

200 – 160 Ma main ore forming processes in 170-200°C, 200Ma - climate changed for humid condition, main U-ore forming epoch

< **160 Ma** and < **40 Ma** - Uranium remobilization, and deposit maturation



Š.Ferenc et al., 2007, 2008, 2010



CONCLUSIONS , model of U-Mo Kurišková deposit

1. The Permian evolution of bimodal basalt – rhyolite volcanism and sedimentation in continental fluvial near sea paleoenvironment conditions
2. Burial metamorphism of host rock complex in greenschist facies ~ 350°C
3. Tectonic exhumation and deformation of host rock complex
4. Leaching of U-Mo from the Permian glassy rhyolitic rocks by infiltrated water ~ 200 Ma on Triassic – Jurassic boundary
5. Transport and contemporaneous infiltration of U-Mo bearing waters into opening tectonic structures
6. Ore precipitation in suitable tectonically and mechanical (basalte body) environment and geochemical barriers (sorption on apatite crystals and reduction in chlorite rich zones in condition ≤ 200°C.
7. Ore maturation and restricted ore remobilization in fluctuated Eh-pH condition in current deposit space

Ludovika Energy s.r.o.

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ŠTÁTNY GEOLOGICKÝ ÚSTAV DIONÝZA ŠTÚRA MENTE ET MALLEO

Geologický ústav Slovenská akadémia vied