

TITANITE (SPHENE)

Chemical formula: $\text{CaTi}[\text{O}|\text{SiO}_4]$

Crystal system: monoclinic

Color in thin section: shades of brown or yellowish brown, or colorless; nonpleochroic to strongly pleochroic:

X = colorless, pale yellow

Y = yellow, greenish yellow, yellowish brown, pink

Z = orangish brown, greenish brown, green, redish brown, red

Form: rounded or irregular allotriomorphic grains, often idiomorphic to hypidiomorphic grains with wedge- or diamond-shaped cross section

Cleavage: good on {110}, perfect on {111}

Indices of refraction: $n_\alpha = 1.843 - 1.950$ $n_\beta = 1.870 - 2.034$ $n_\gamma = 1.943 - 2.110$

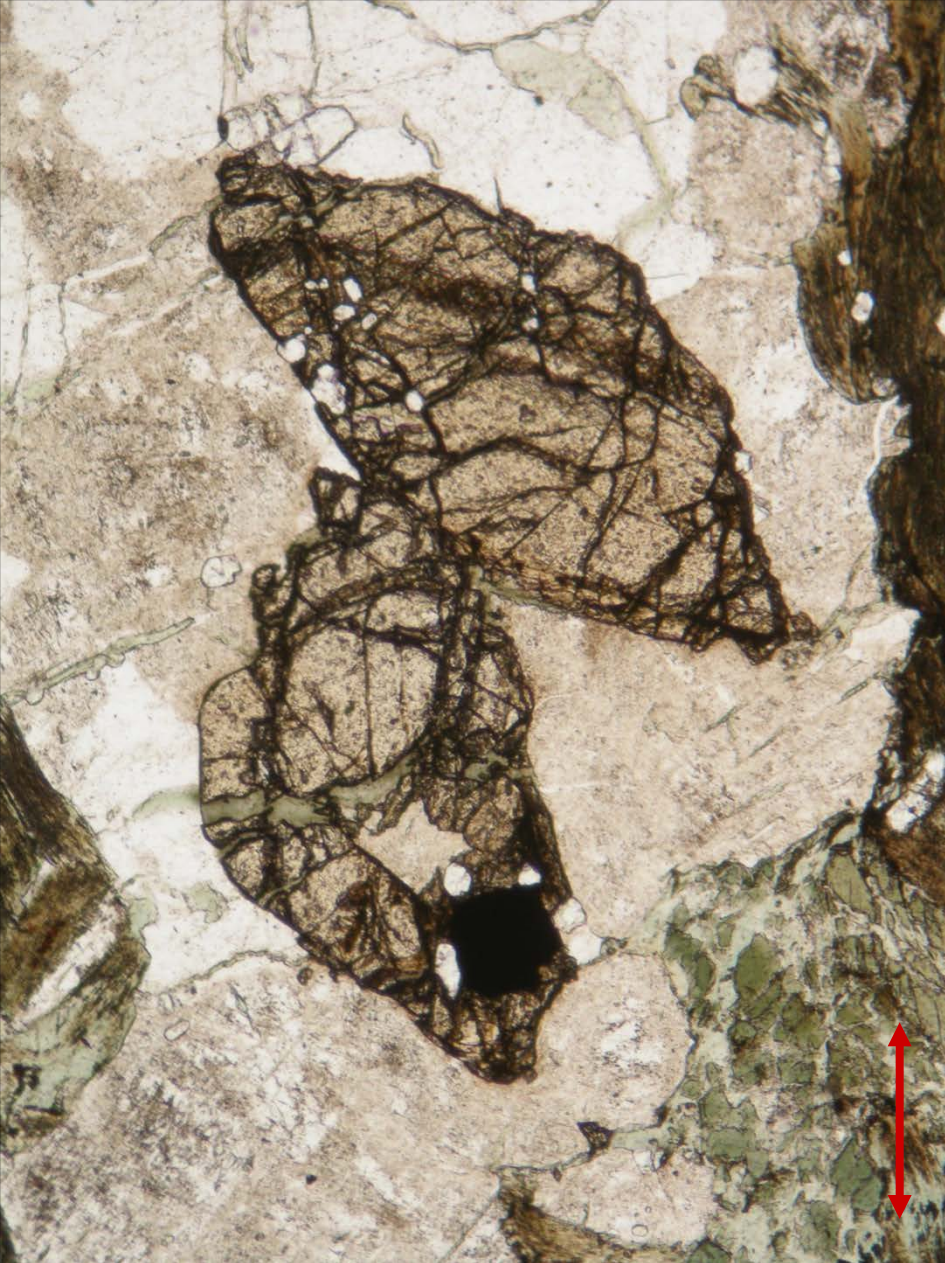
Birefringence: 0.100 – 0.192

Optic sign: biaxial positive

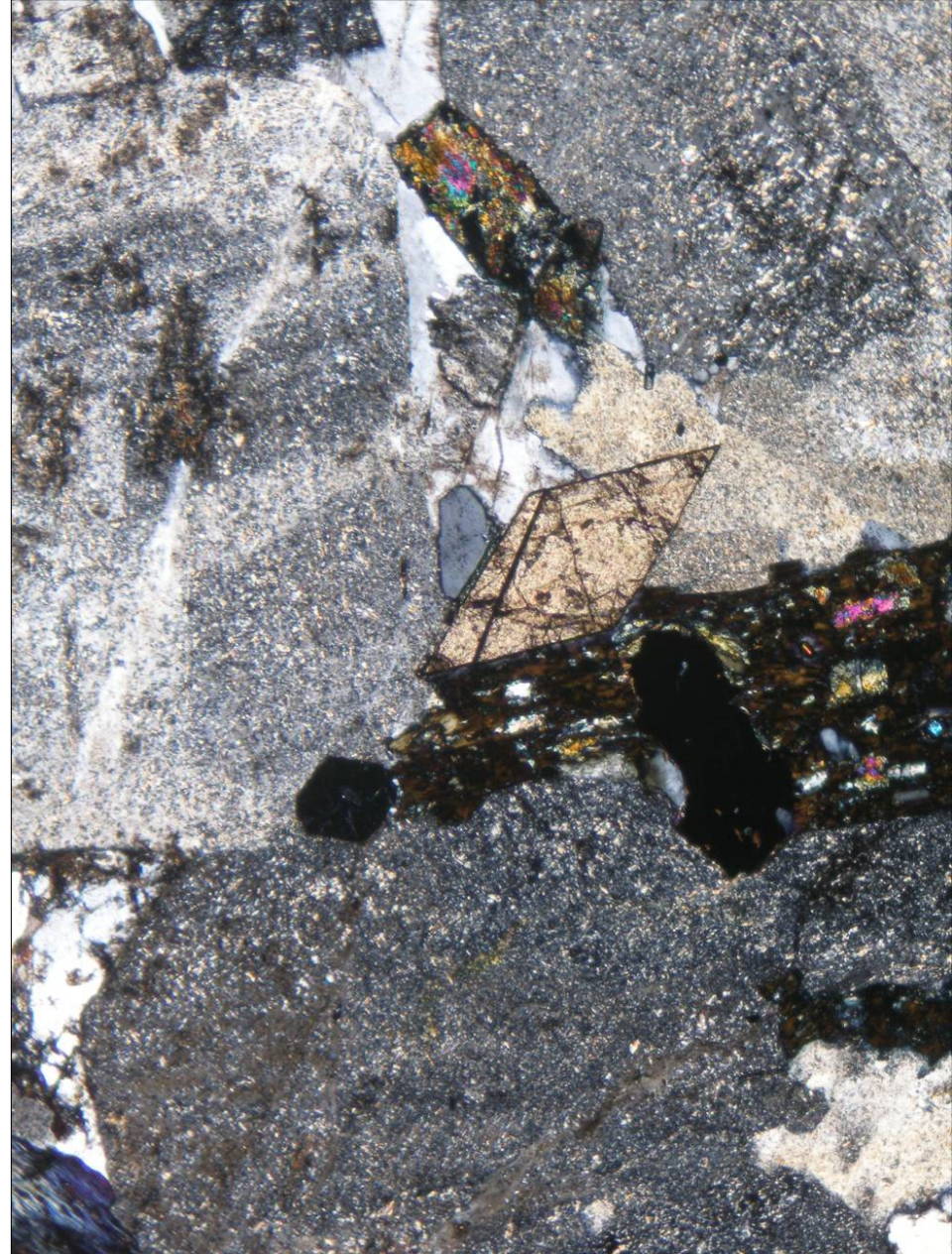
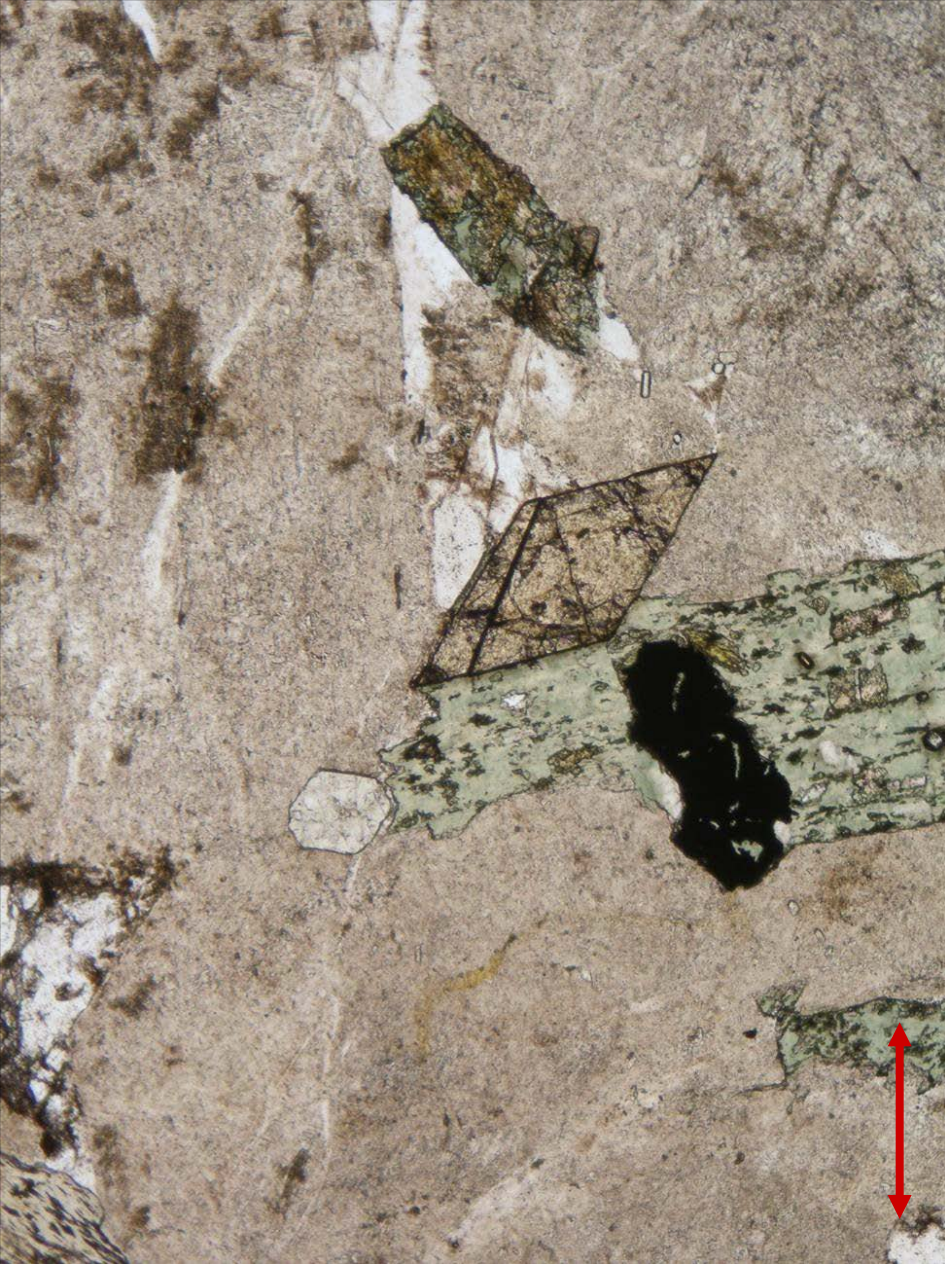
Alteration: may be altered to leucoxene (an aggregate of Ti-oxides, quartz, calcite, and other minerals)

Occurrence: a common accessory mineral in magmatites (syenite, granodiorite, monzonite, diorite, phonolite) and metamorphic rocks (calc-silicate rocks, amphibolite, gneiss, marble)

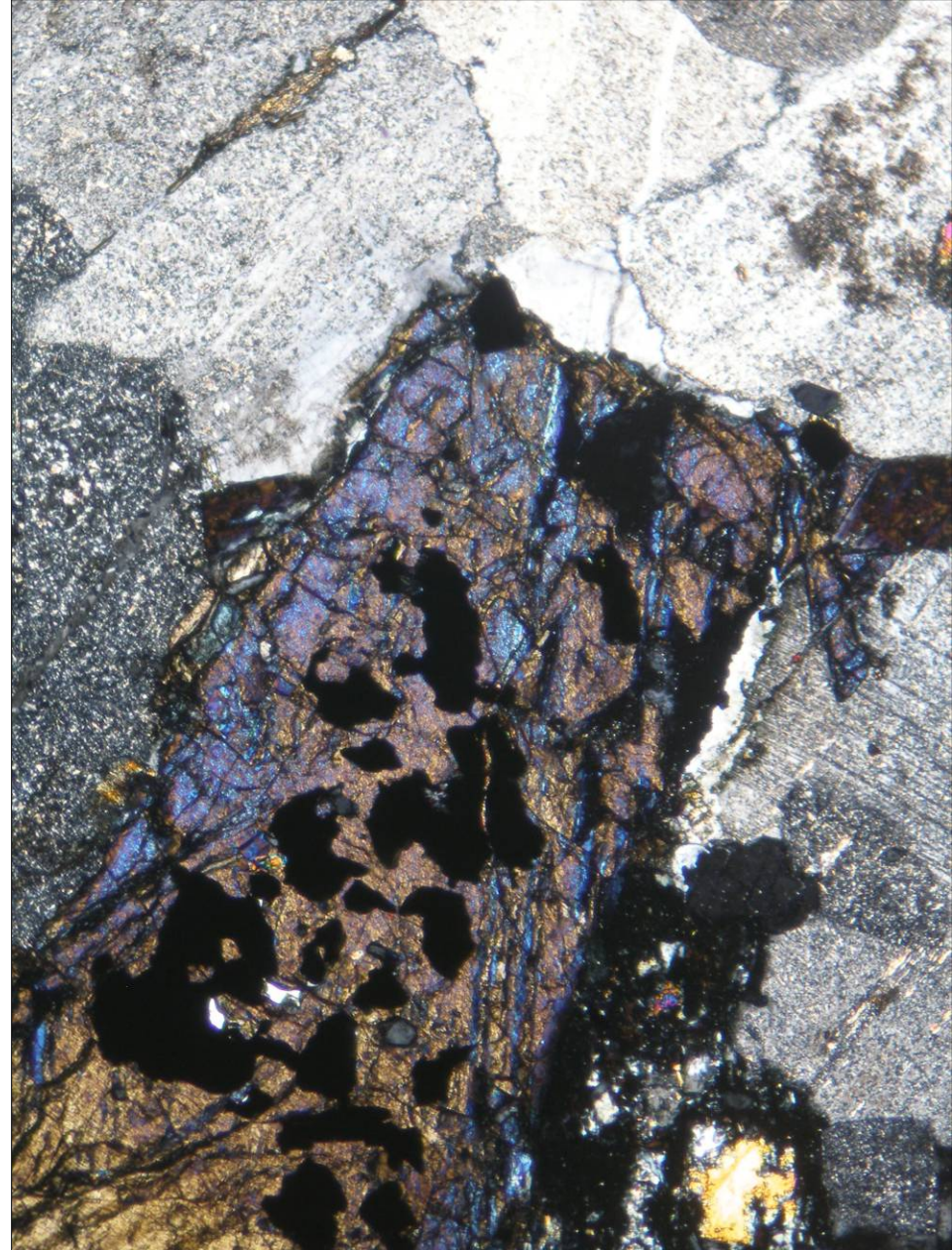
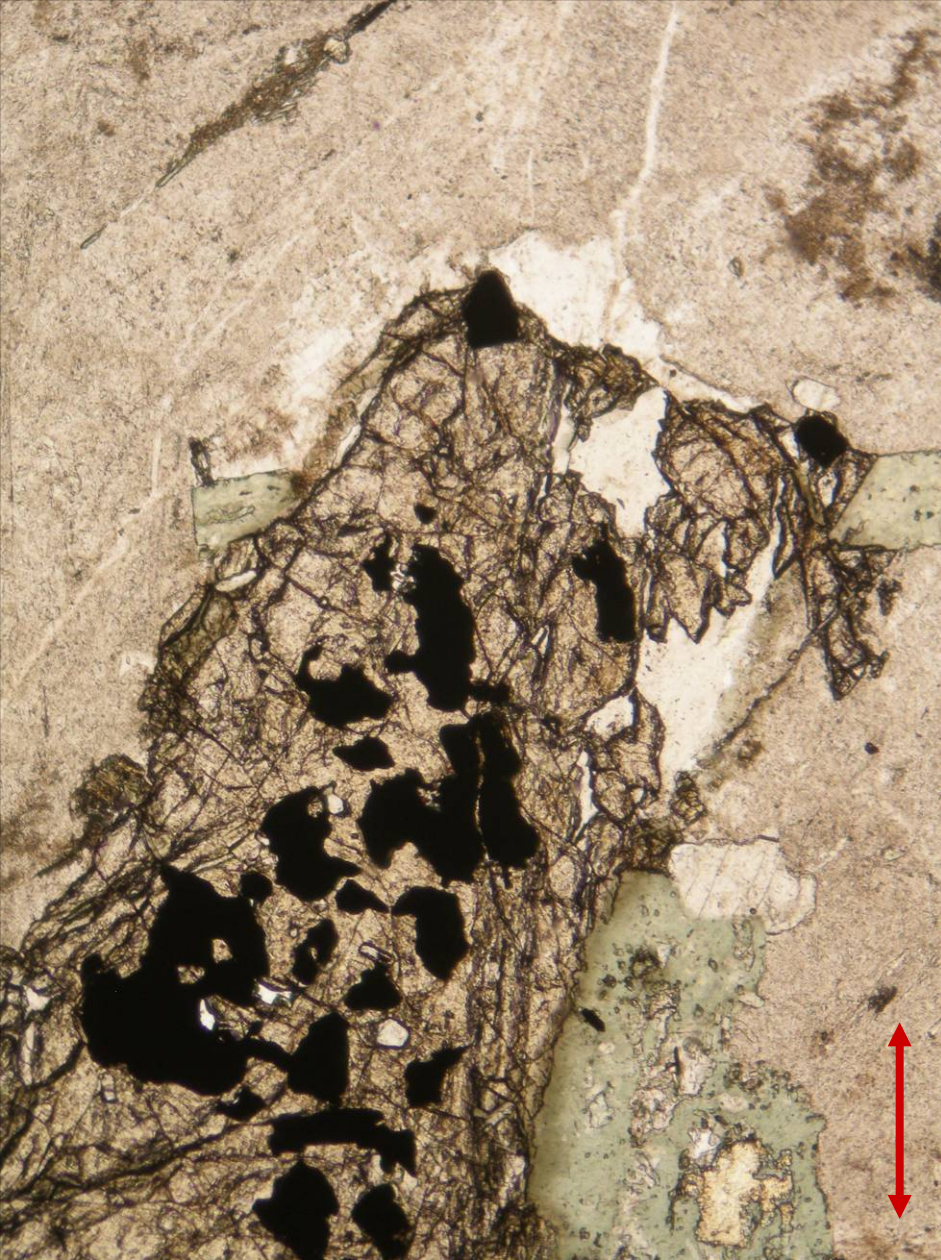
Similar minerals in thin sections: monazite (lower birefringence, lower indices), xenotime (uniaxial), rutile (uniaxial)



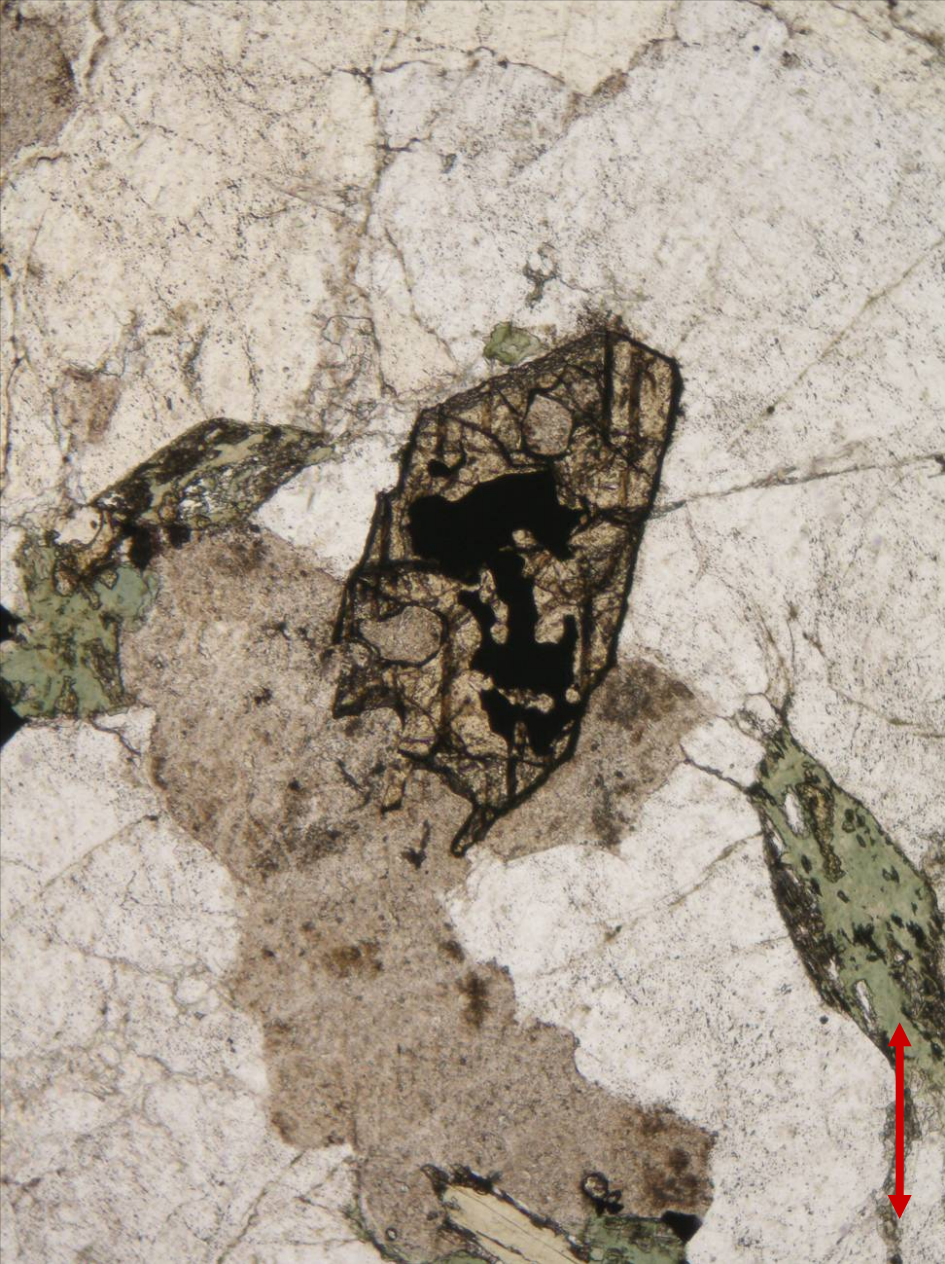
Titanite in granodiorite from Brno-Obřany, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 1.8 mm. Photo: JiZi.



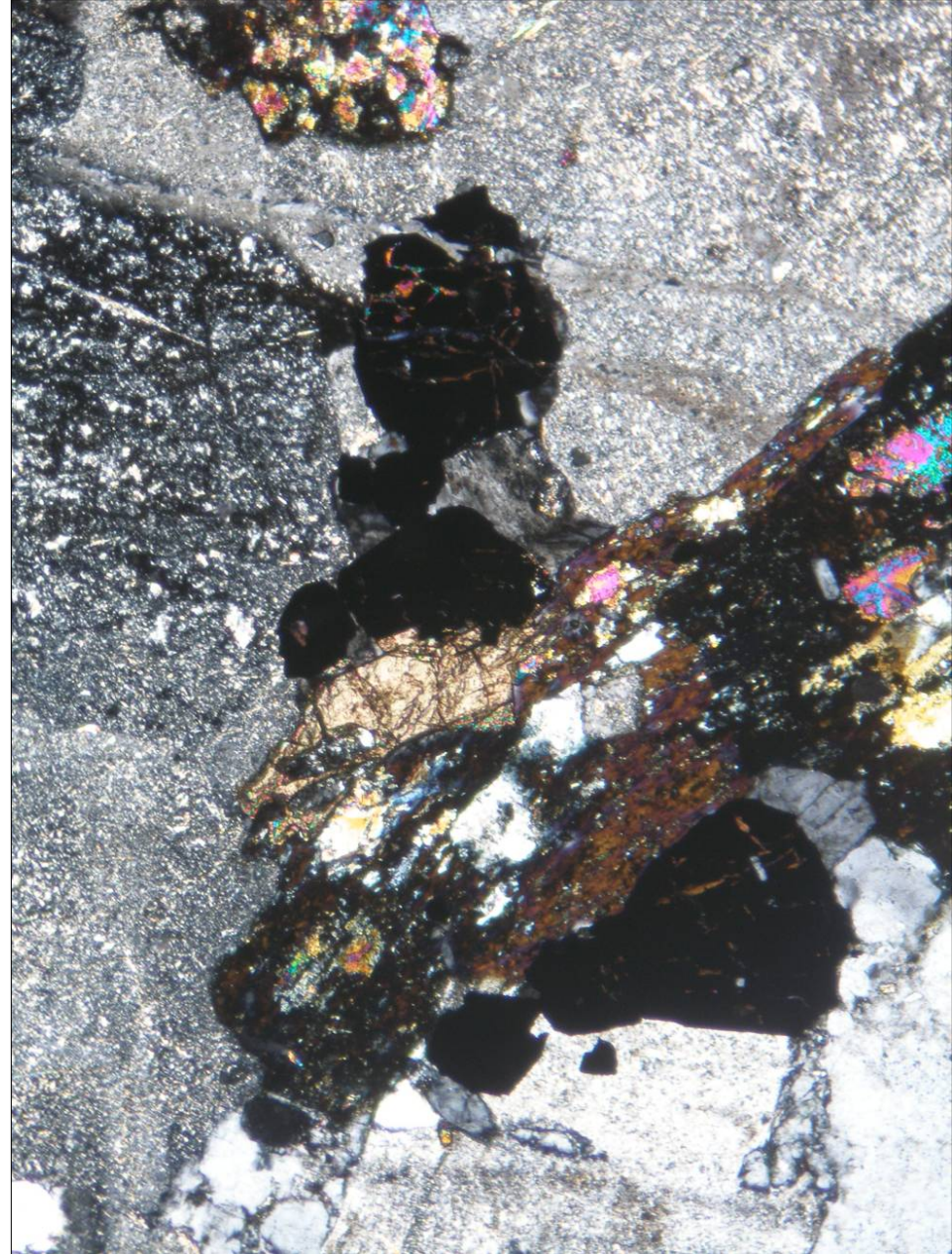
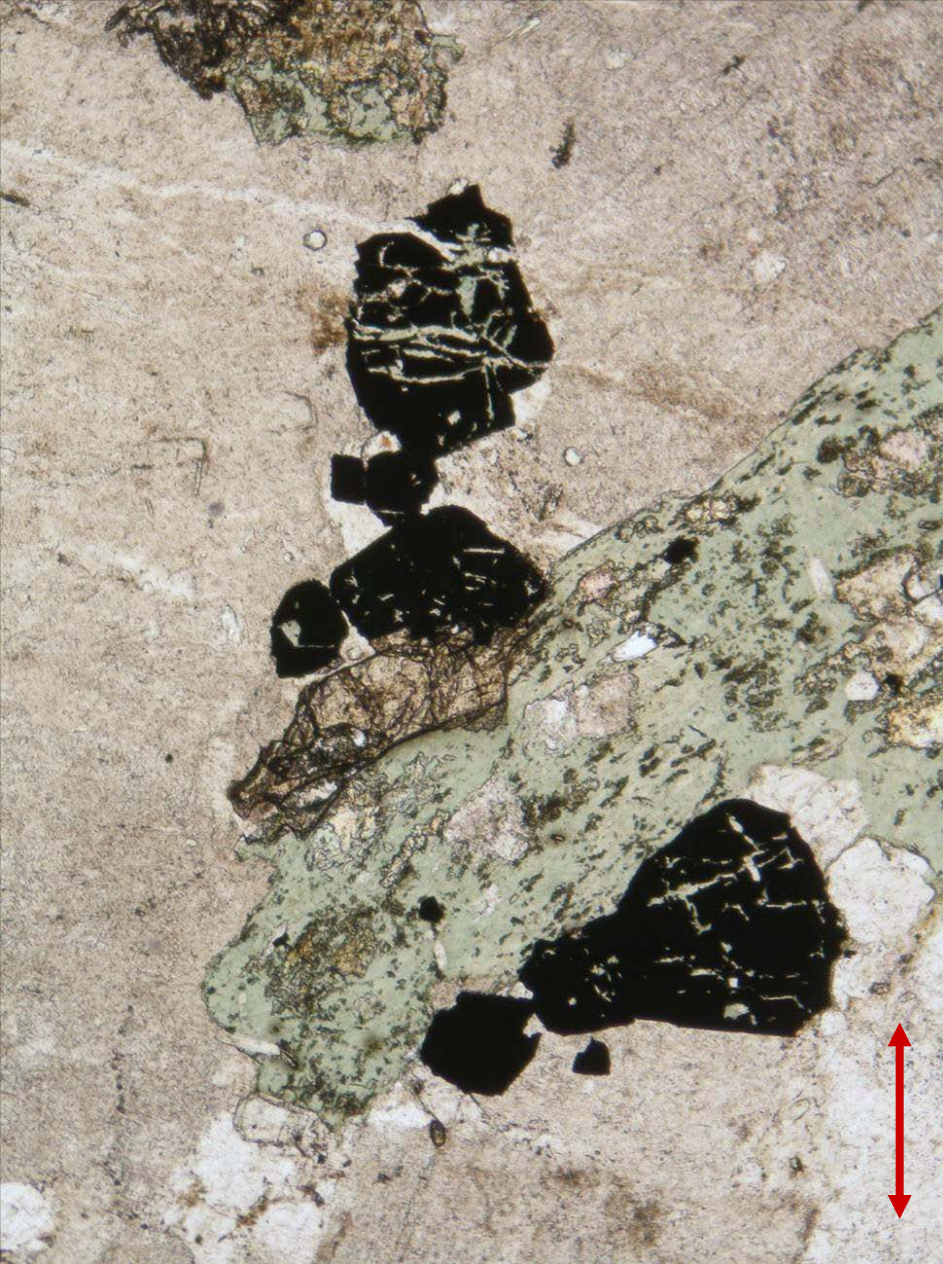
Titanite with hornblende altered to chlorite in granodiorite from Blansko, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 1.5 mm. Photo: JiZi.



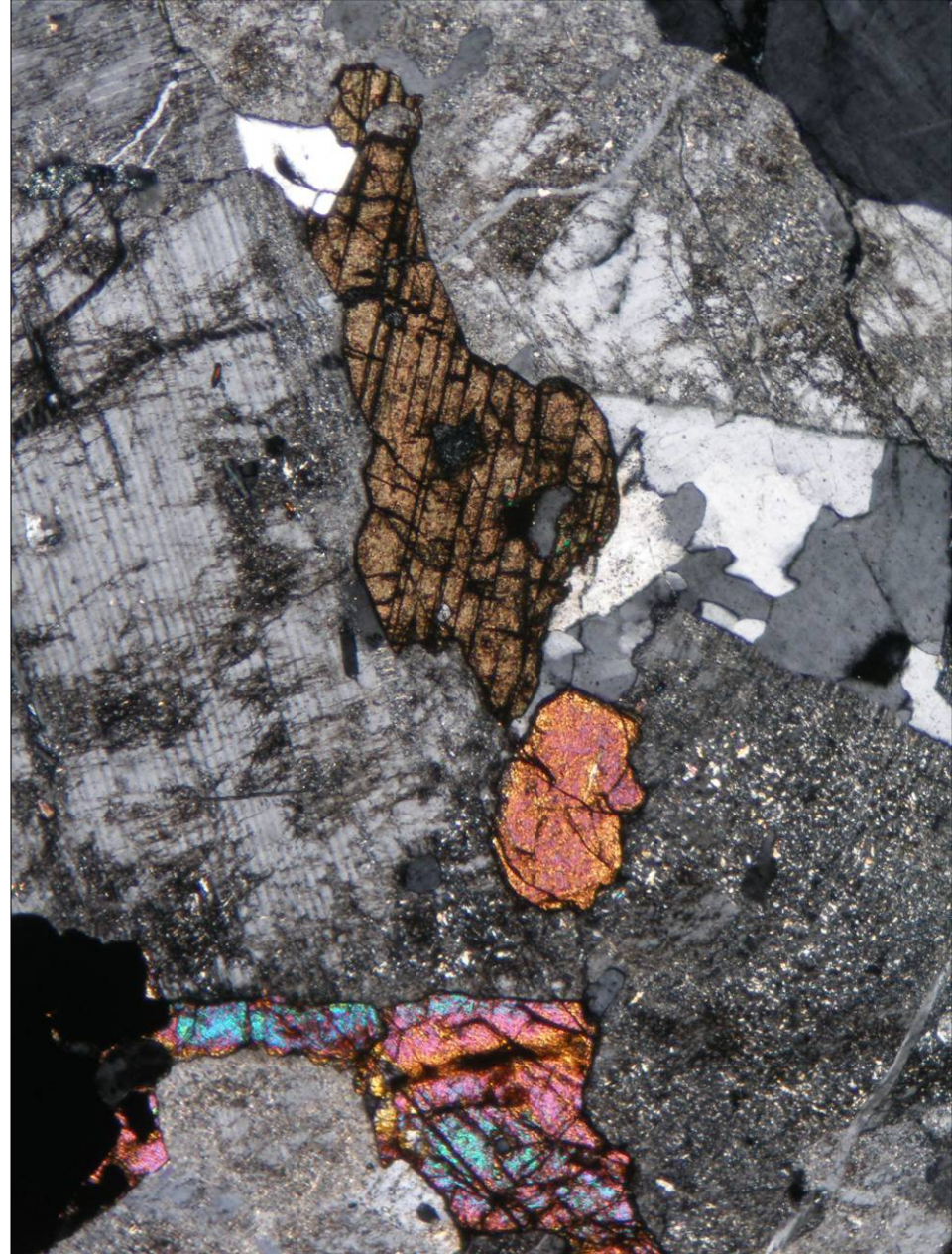
Titanite and an opaque mineral in granodiorite from Blansko, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 1.5 mm. Photo: JiZi.



Titanite with opaque inclusions in granodiorite from Blansko, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 1.5 mm. Photo: JiZi.



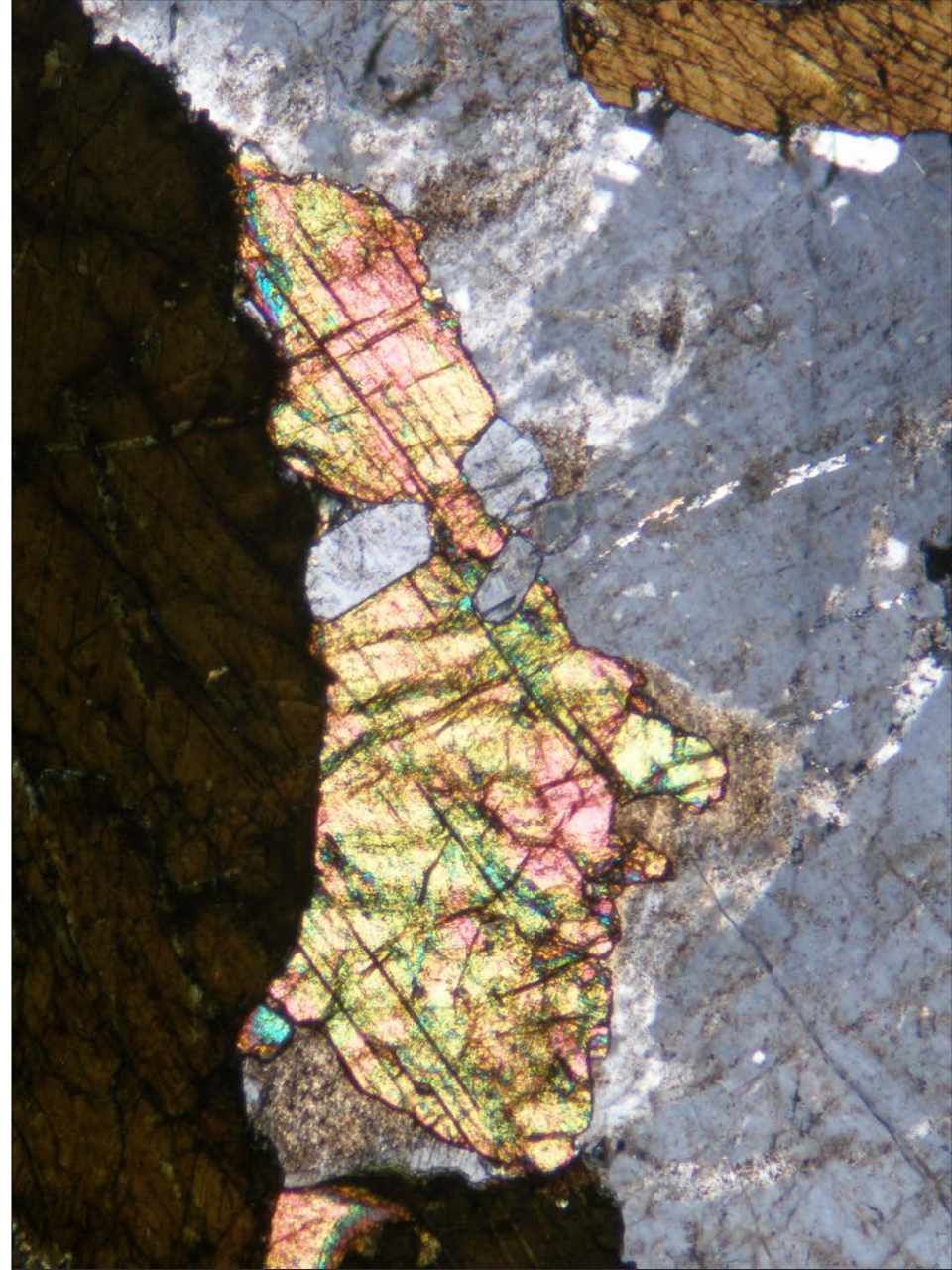
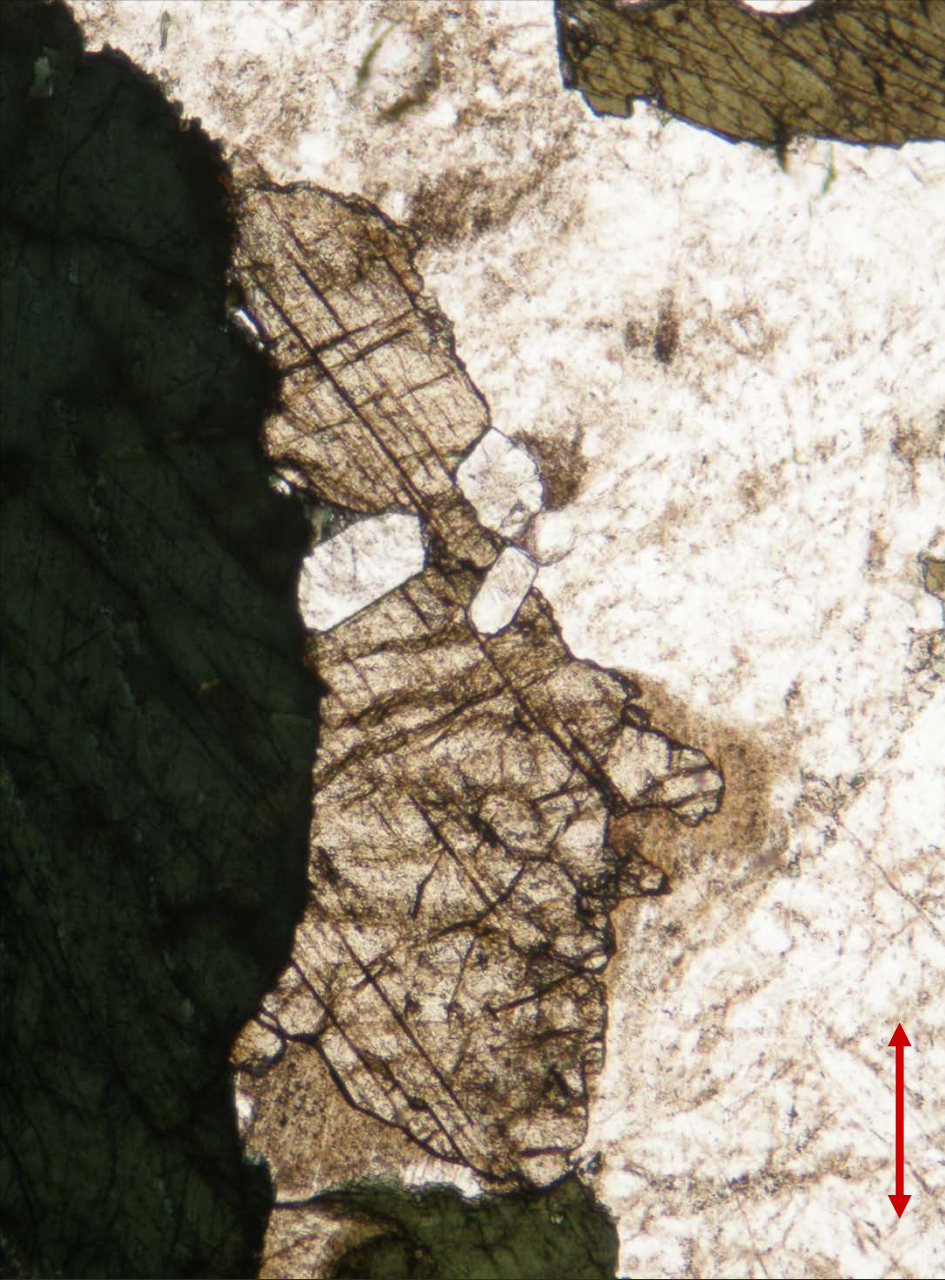
Titanite, opaque grains and hornblende altered to chlorite and epidote in granodiorite from Blansko, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 1.6 mm. Photo: JiZi.



Titanite in granodiorite from Brno-Obřany, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 1.7 mm. Photo: JiZi.



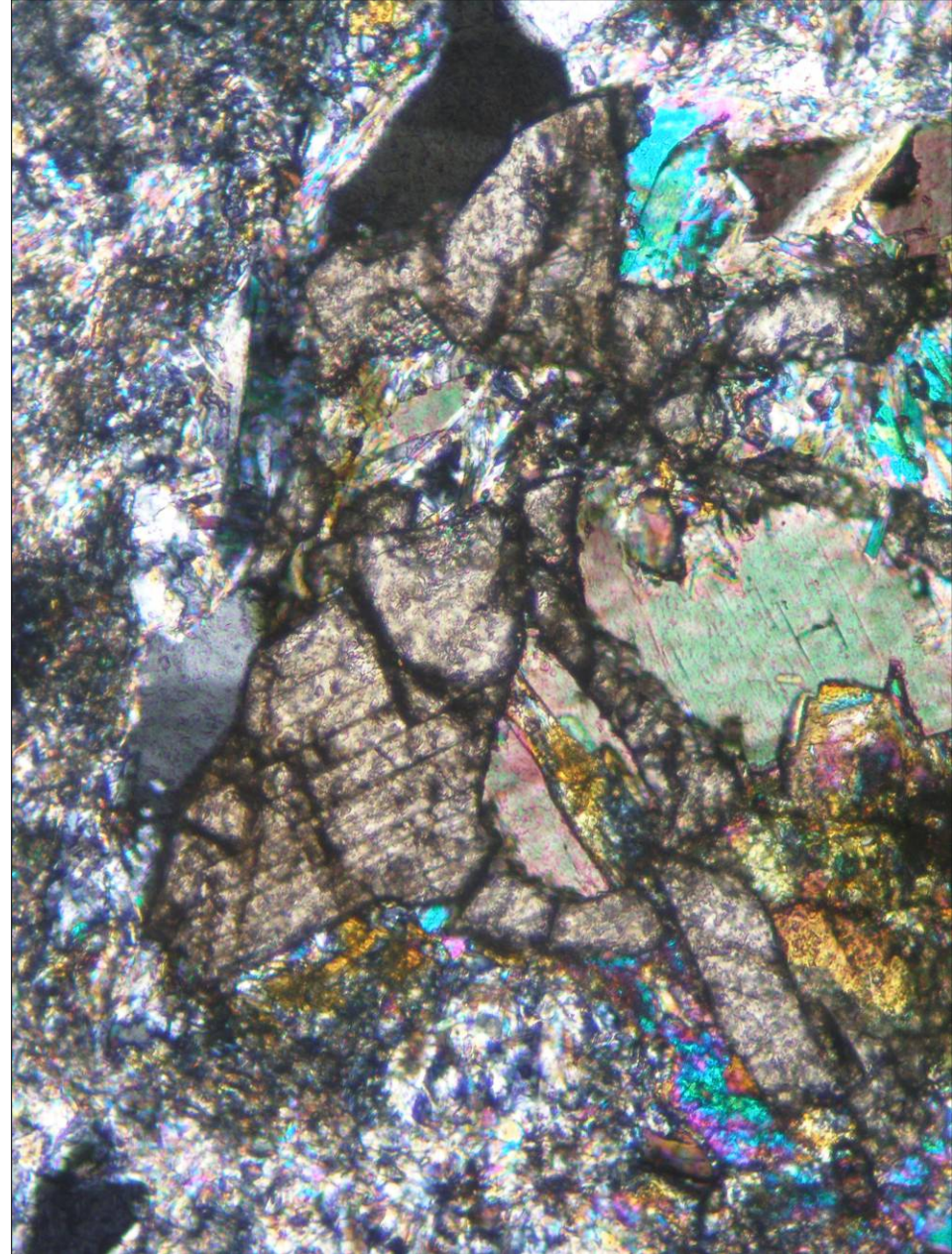
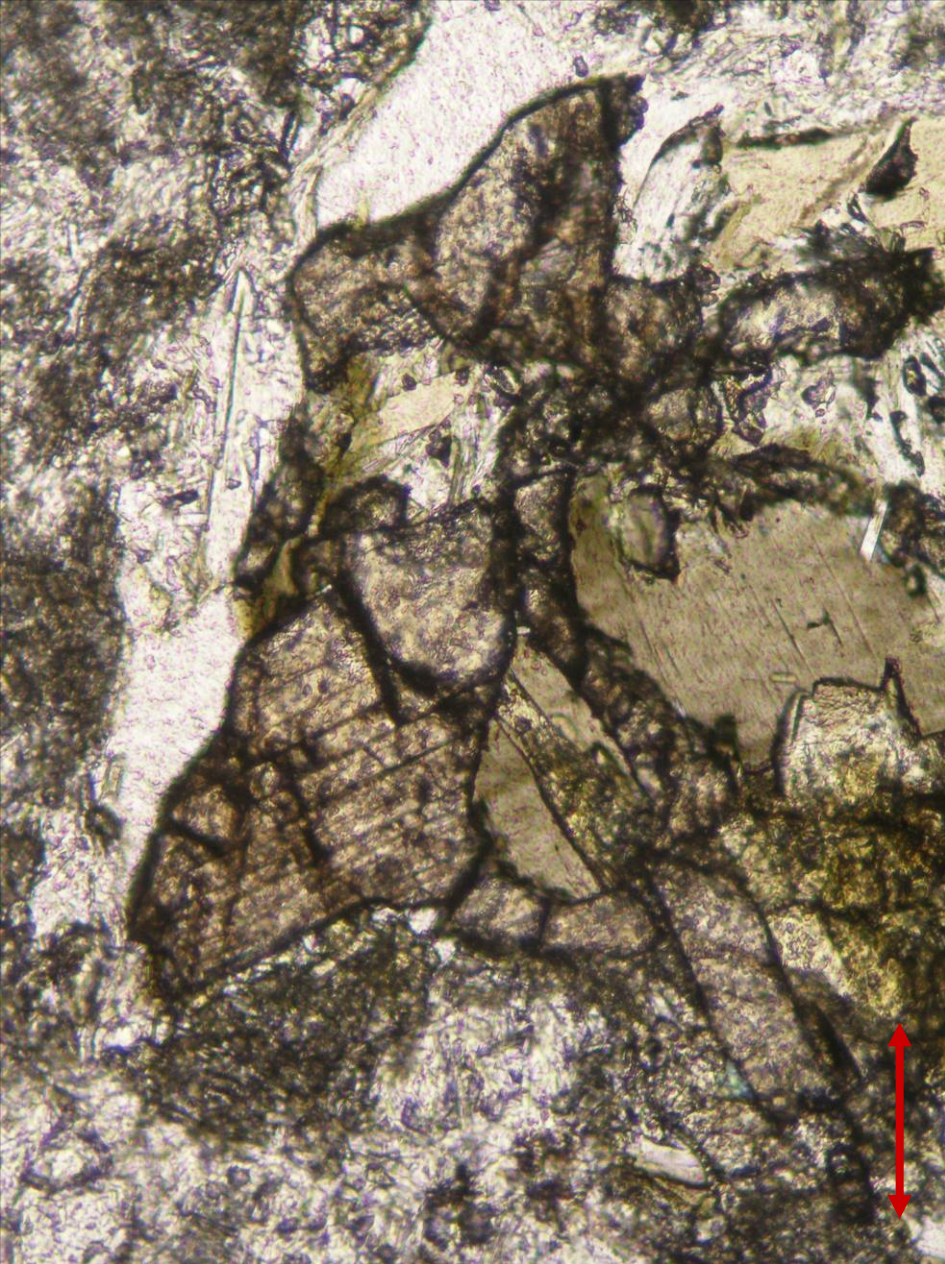
Titanite with quartz and altered feldspars in pegmatite from Supíkovice, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 1.6 mm. Photo: JiZi.



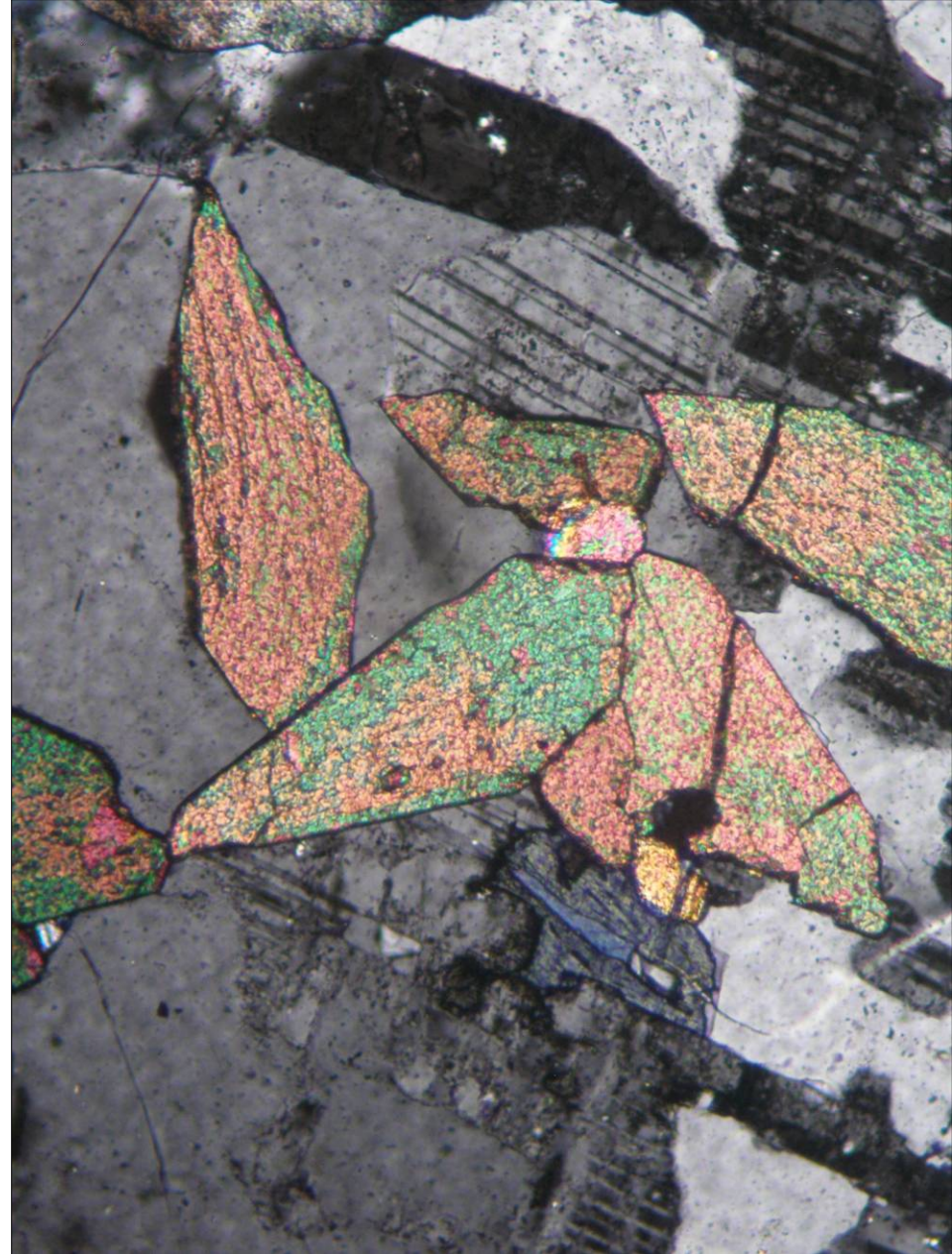
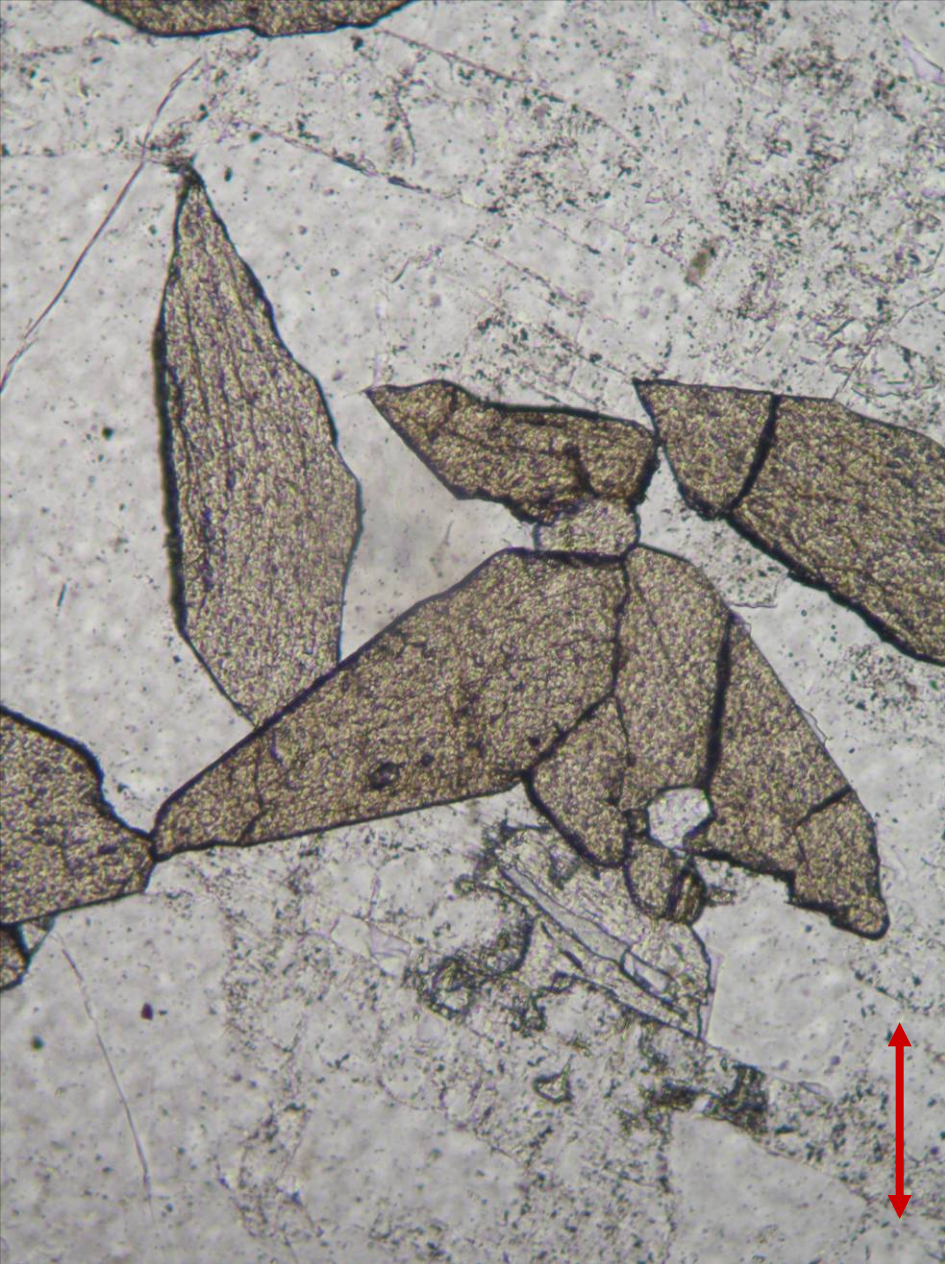
Titanite in pegmatite from Vlastějovice, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 1.4 mm. Photo: JiZi.



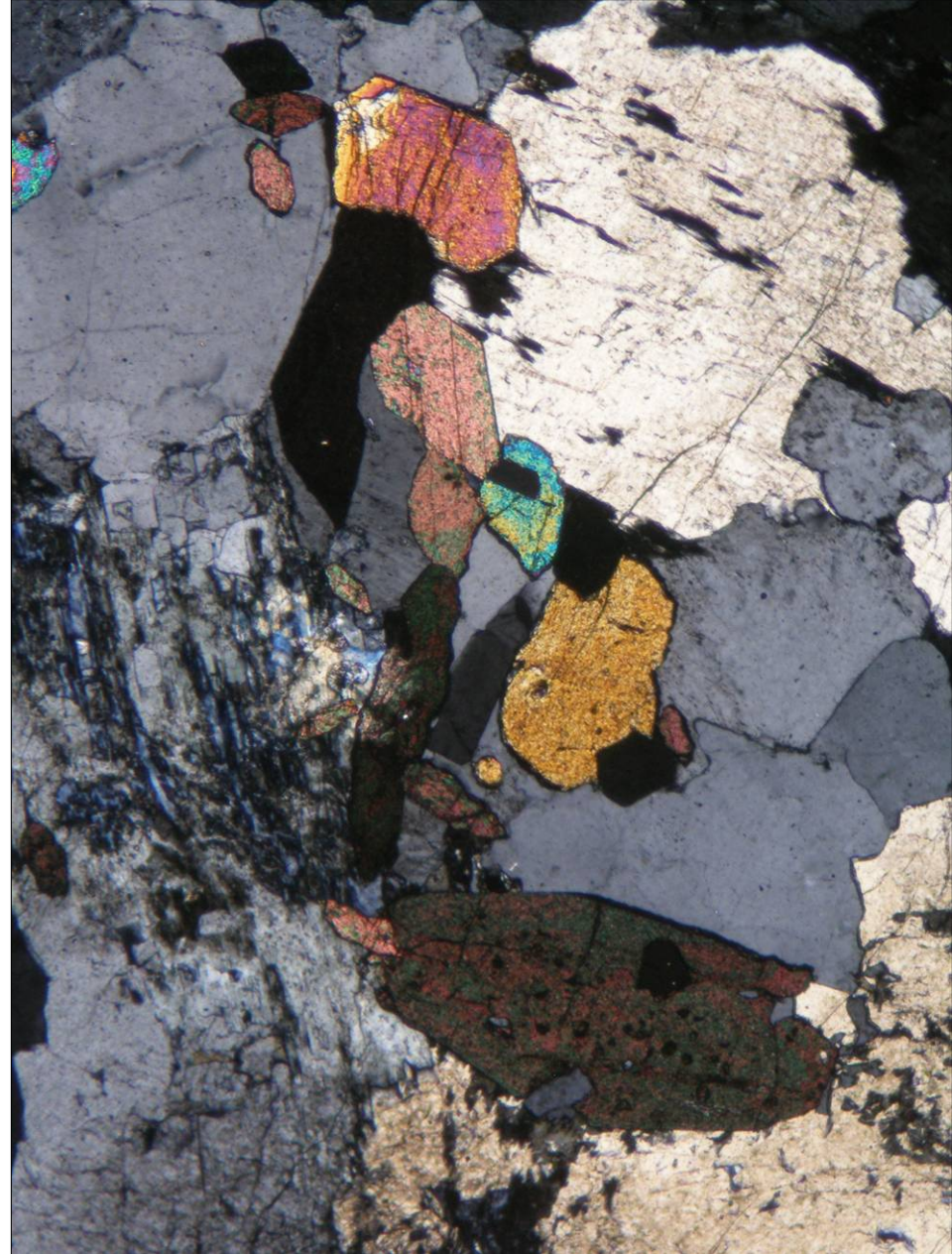
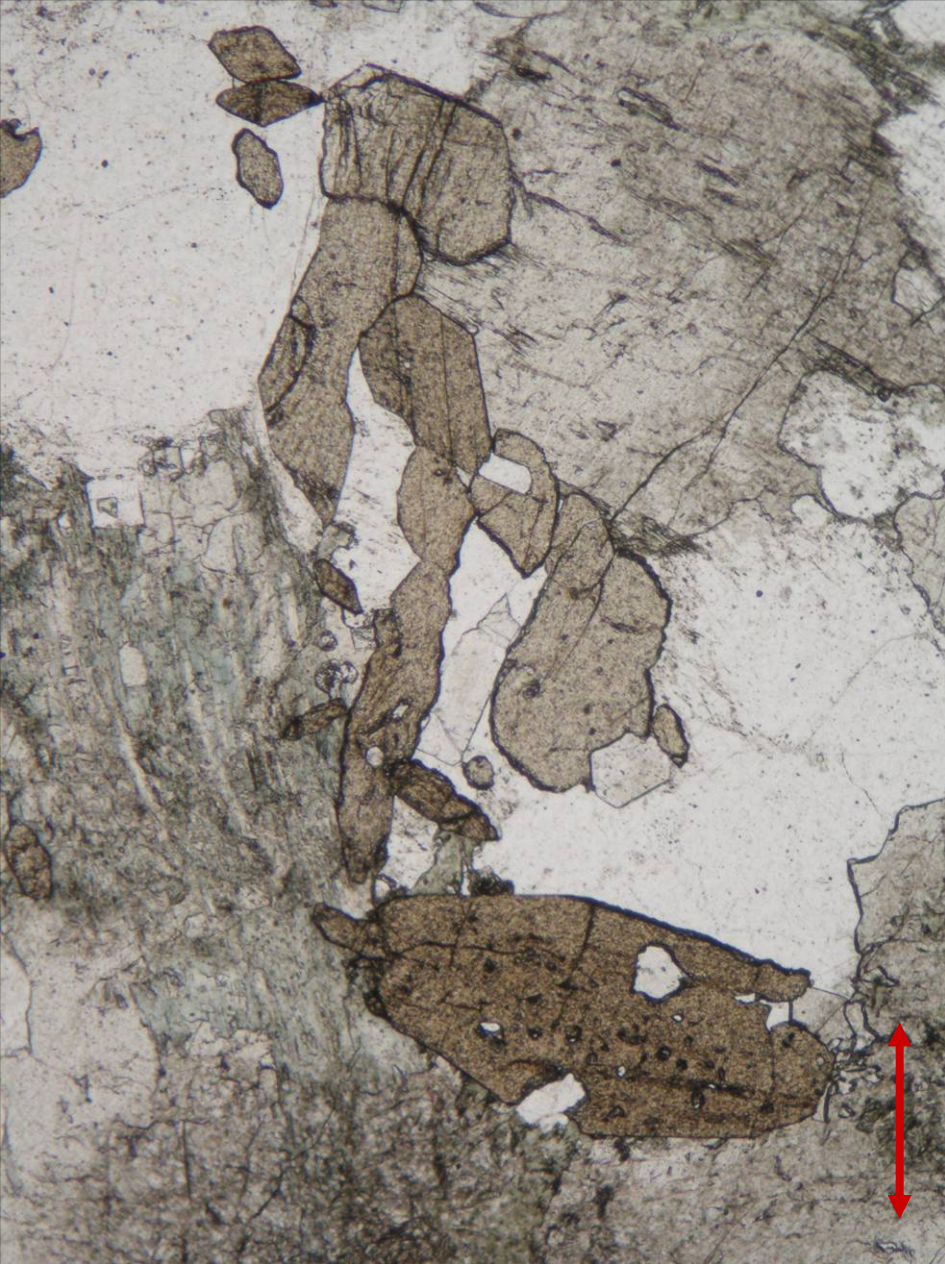
Titanite with quartz and altered feldspars in pegmatite from Supíkovice, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 1.6 mm. Photo: JiZi.



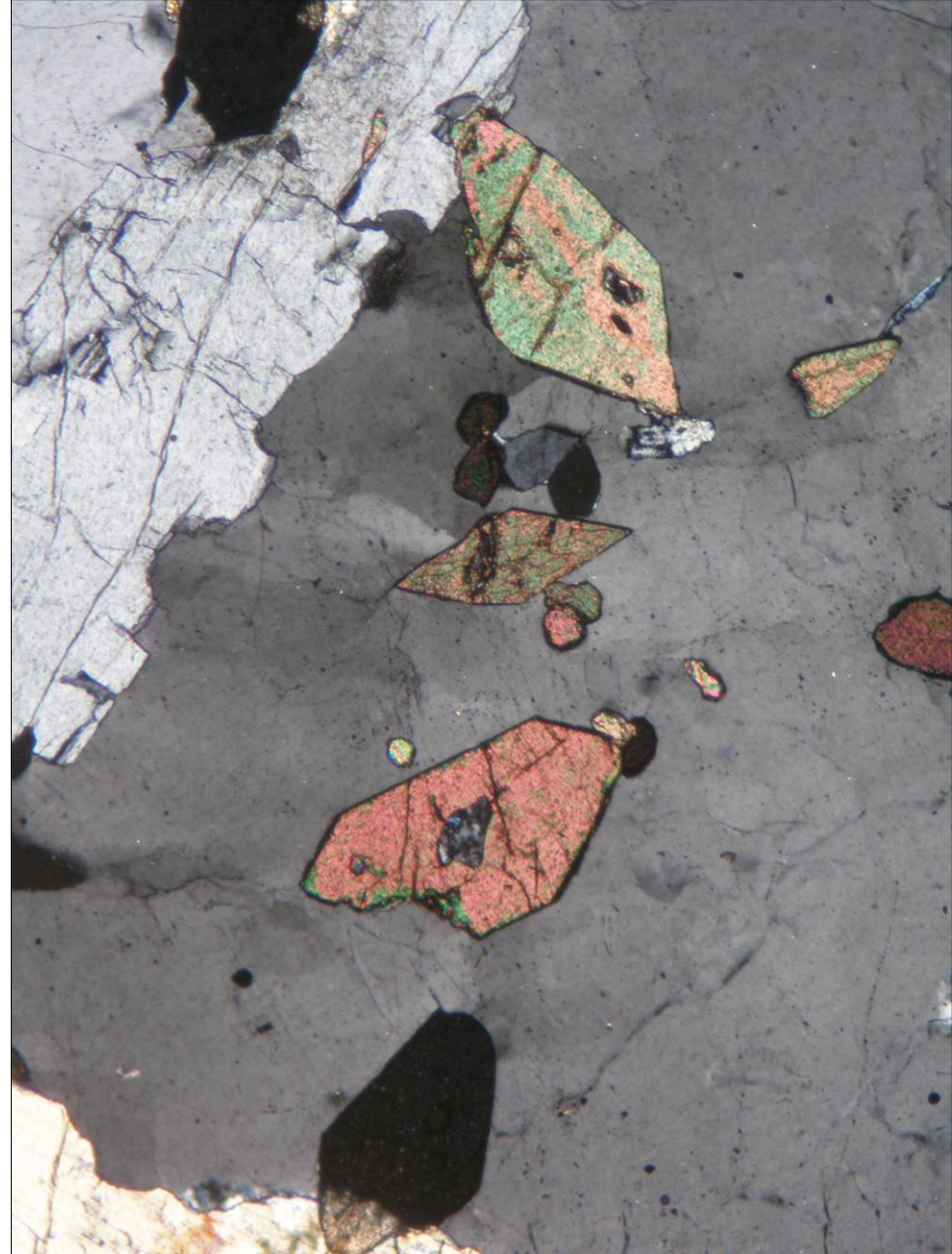
Titanite in tonalite from Sihla, Slovakia; PPL (left) and XPL (right). Width of fields of view is ca. 0.7 mm. Photo: JiZi.



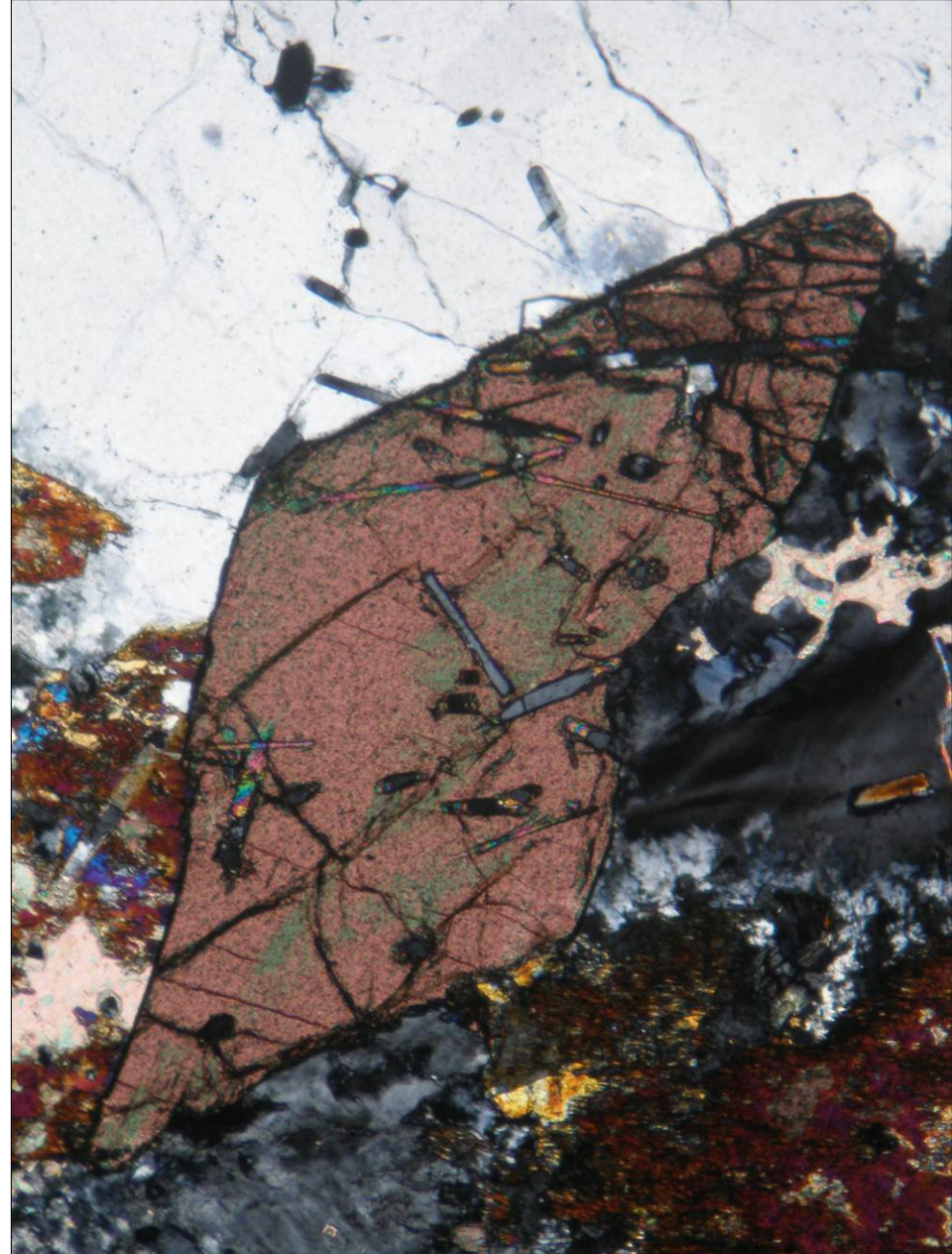
Titanite in pegmatite from Žulová, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 1.8 mm. Photo: JiZi.



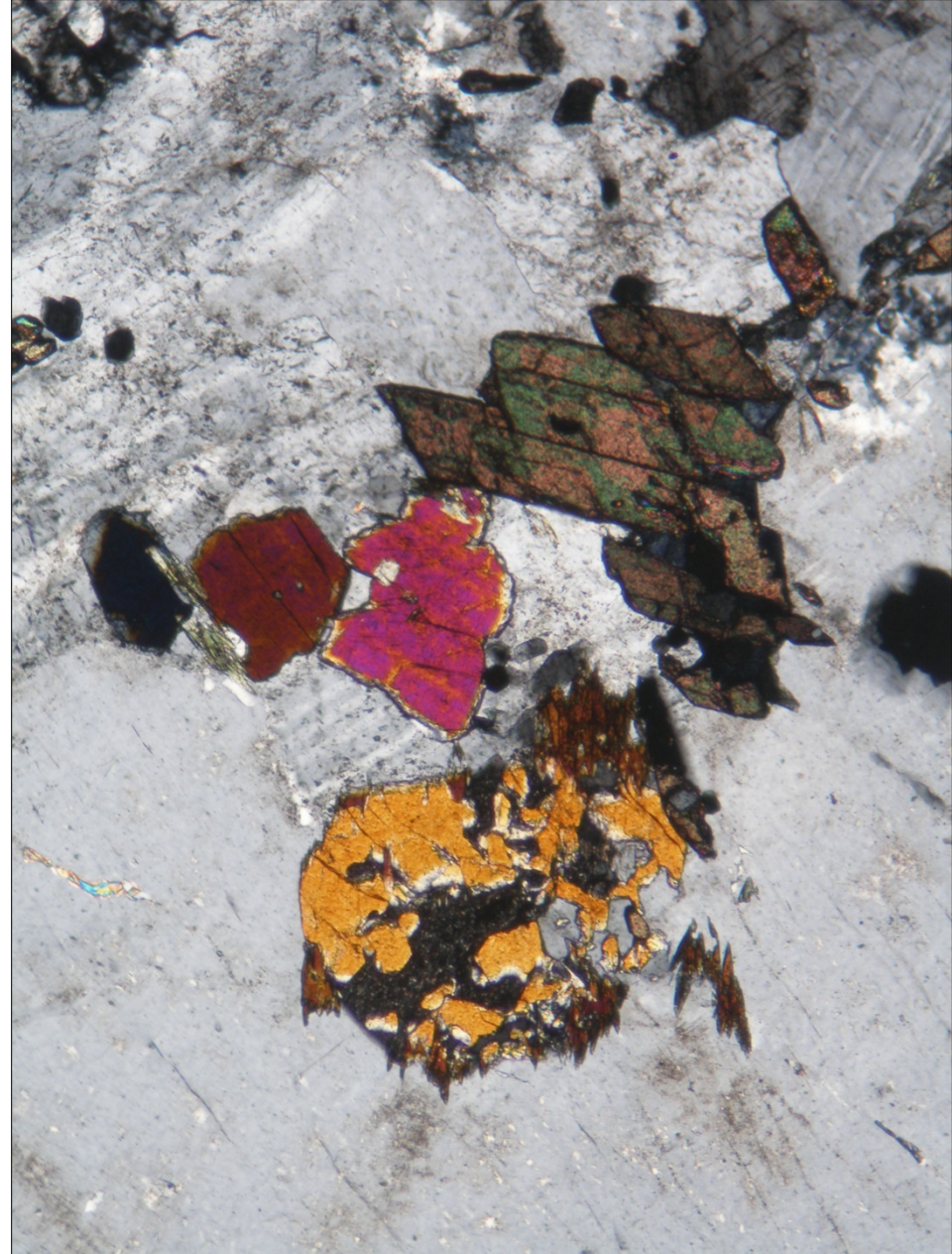
Titanite in pegmatite from Žulová, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 1.8 mm. Photo: JiZi.



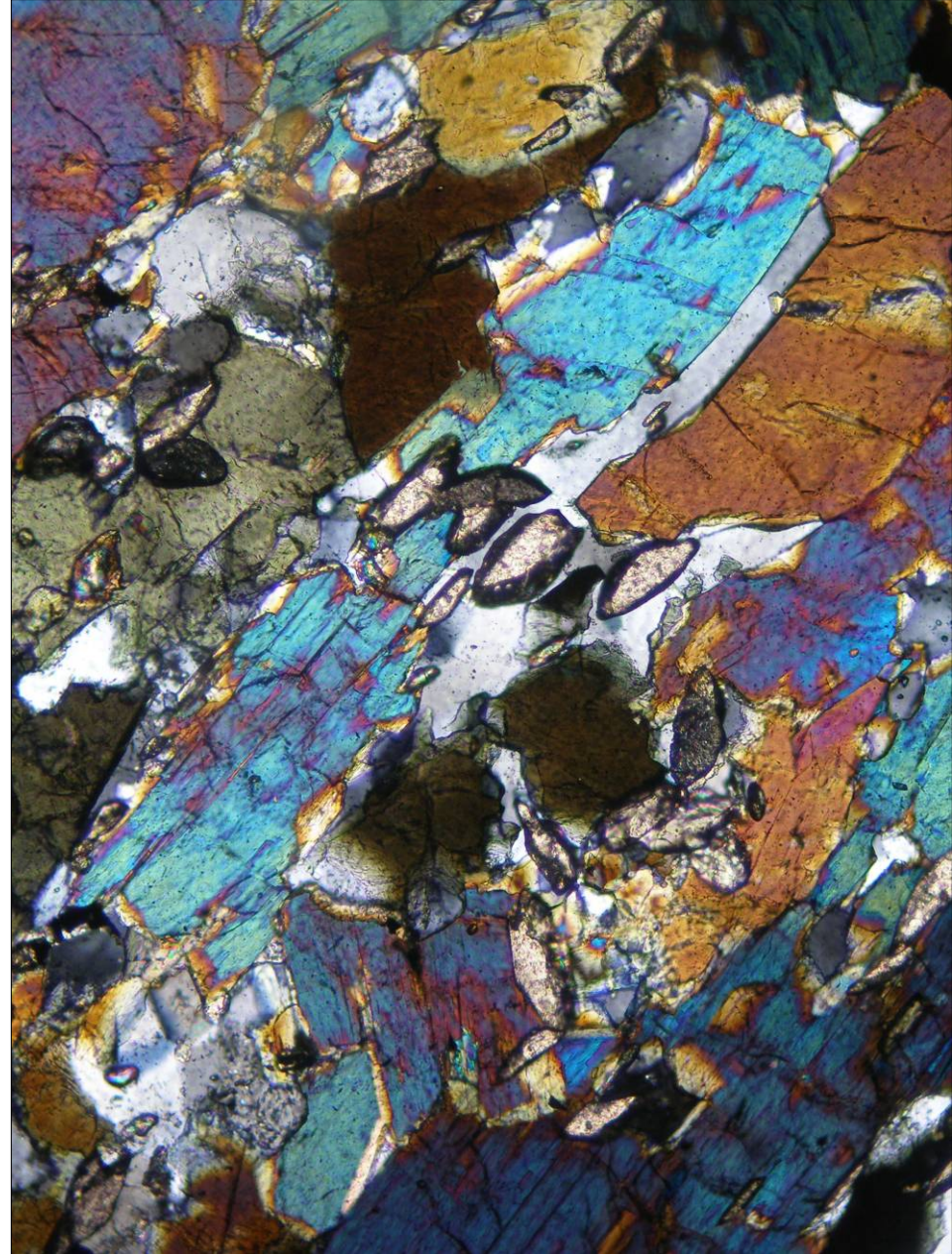
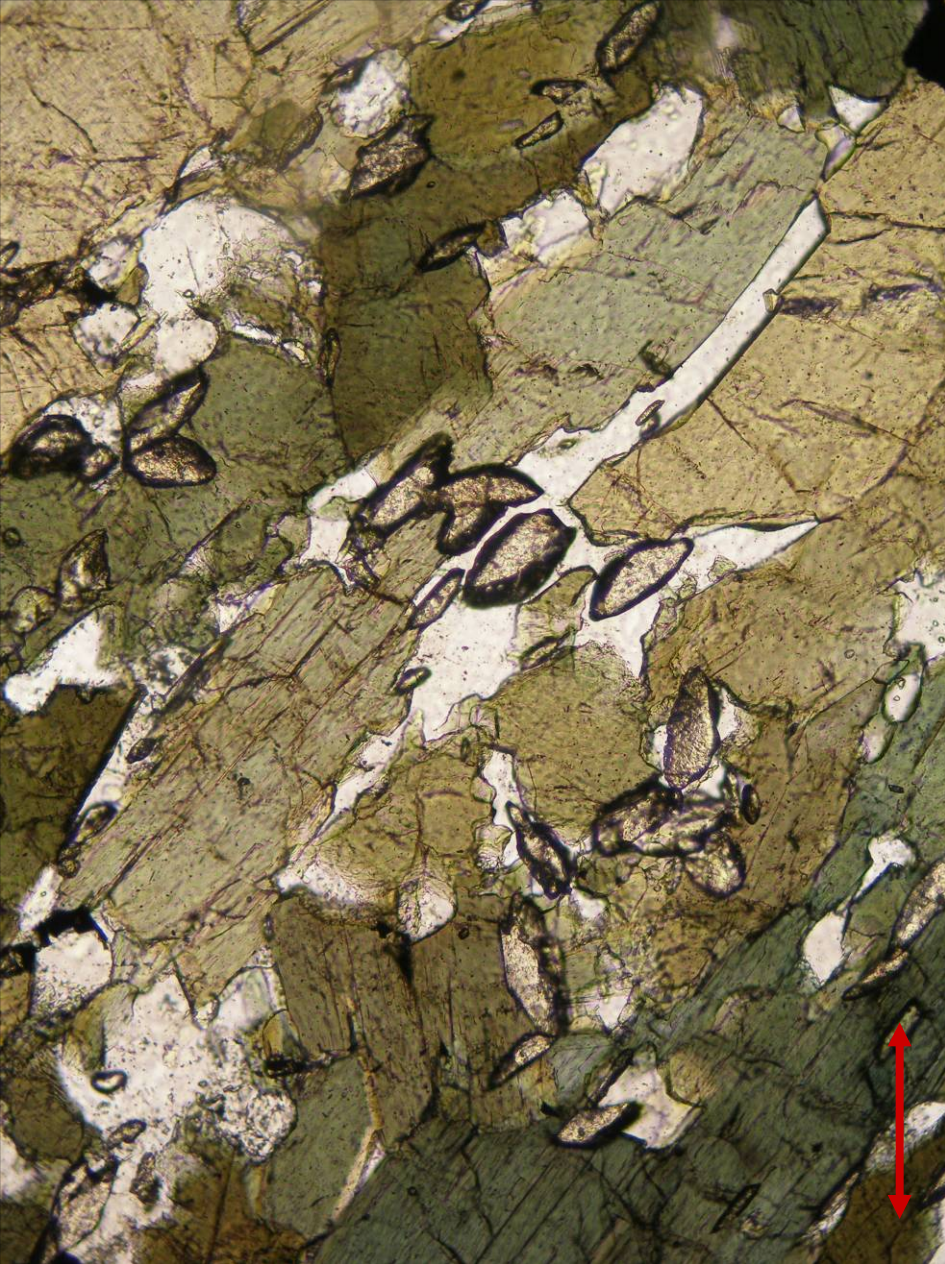
Titanite in pegmatite from Žulová, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 1.8 mm. Photo: JiZi.



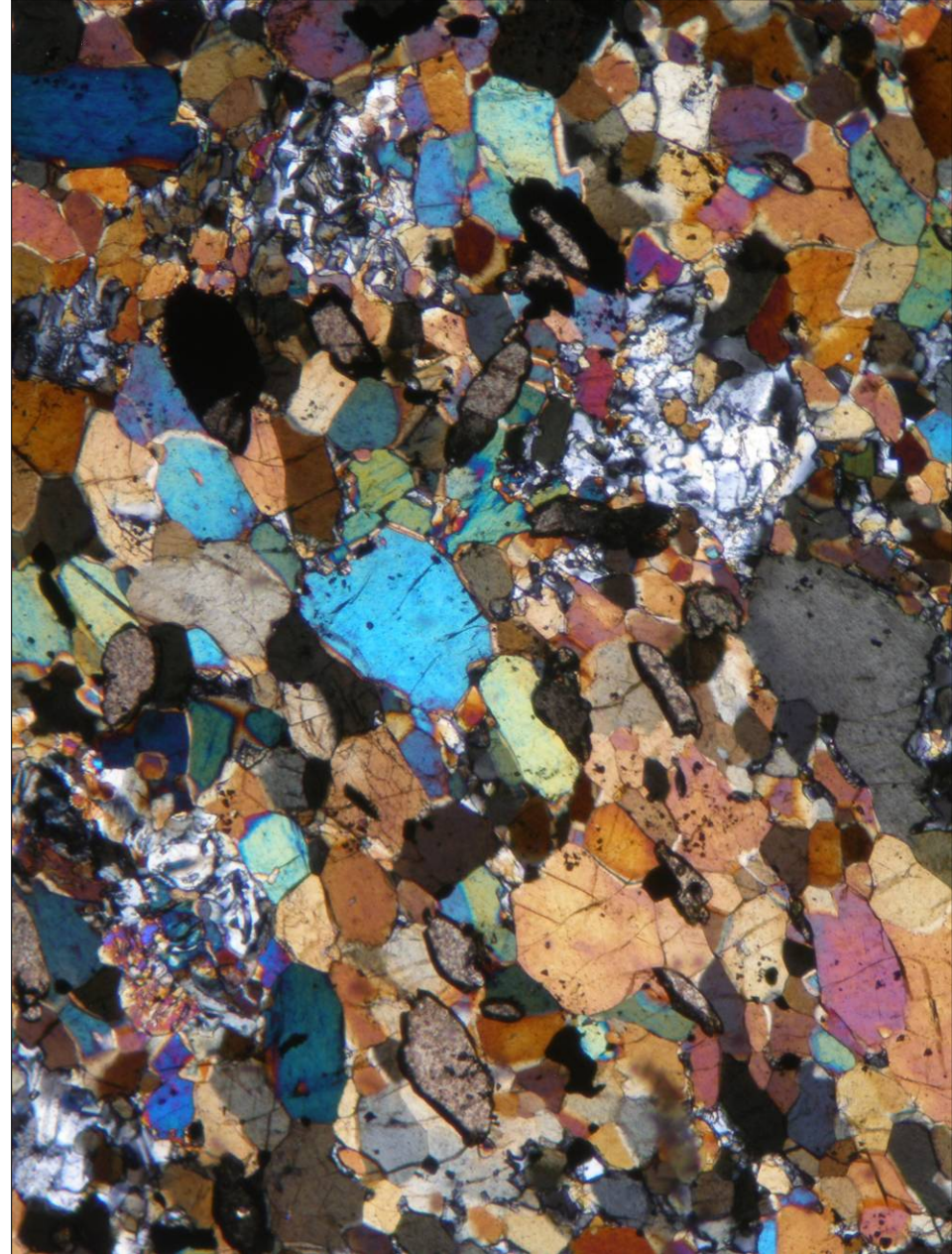
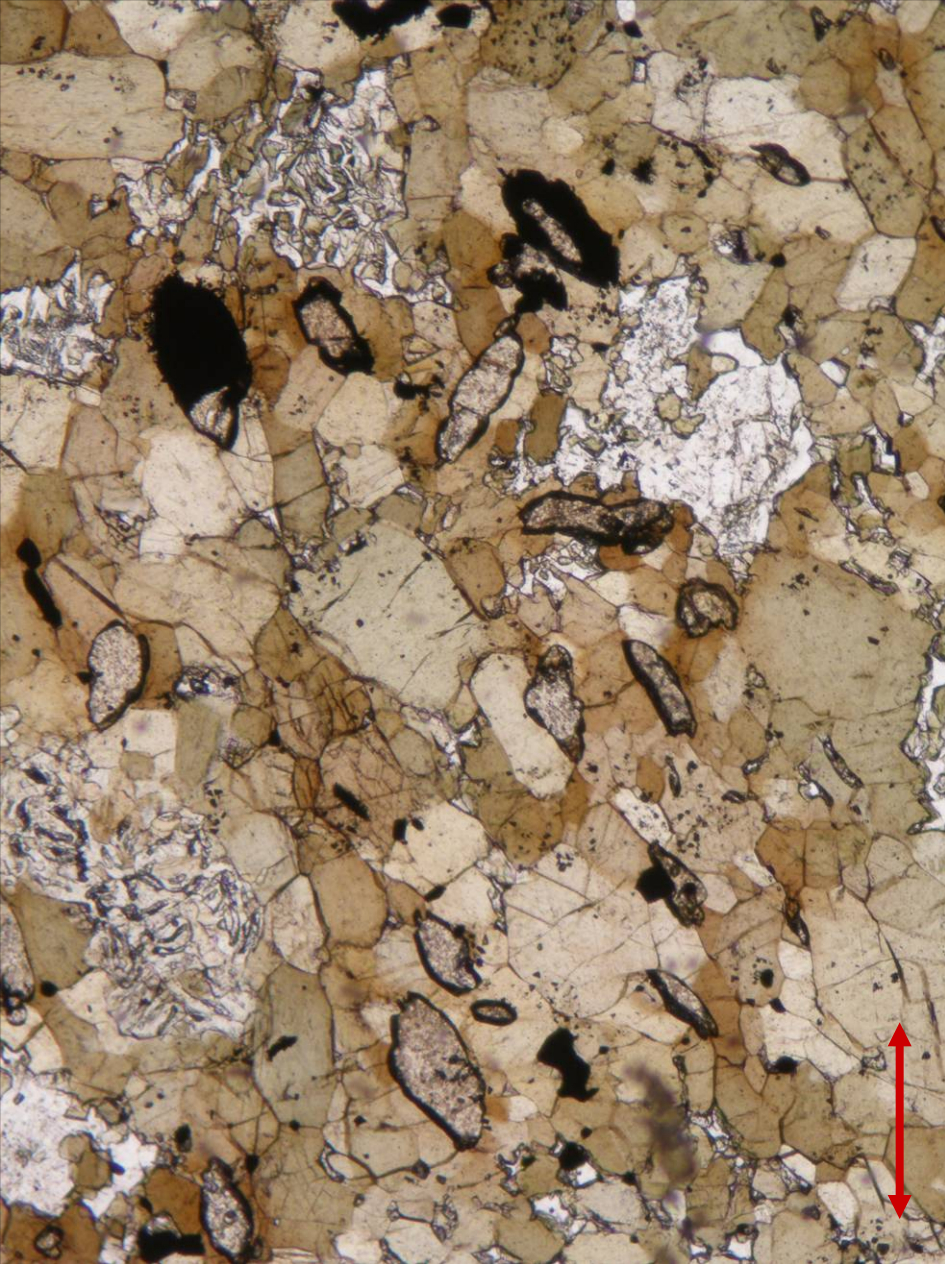
Titanite with apatite inclusions in pegmatite from Žulová, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 2.0 mm. Photo: JiZi.



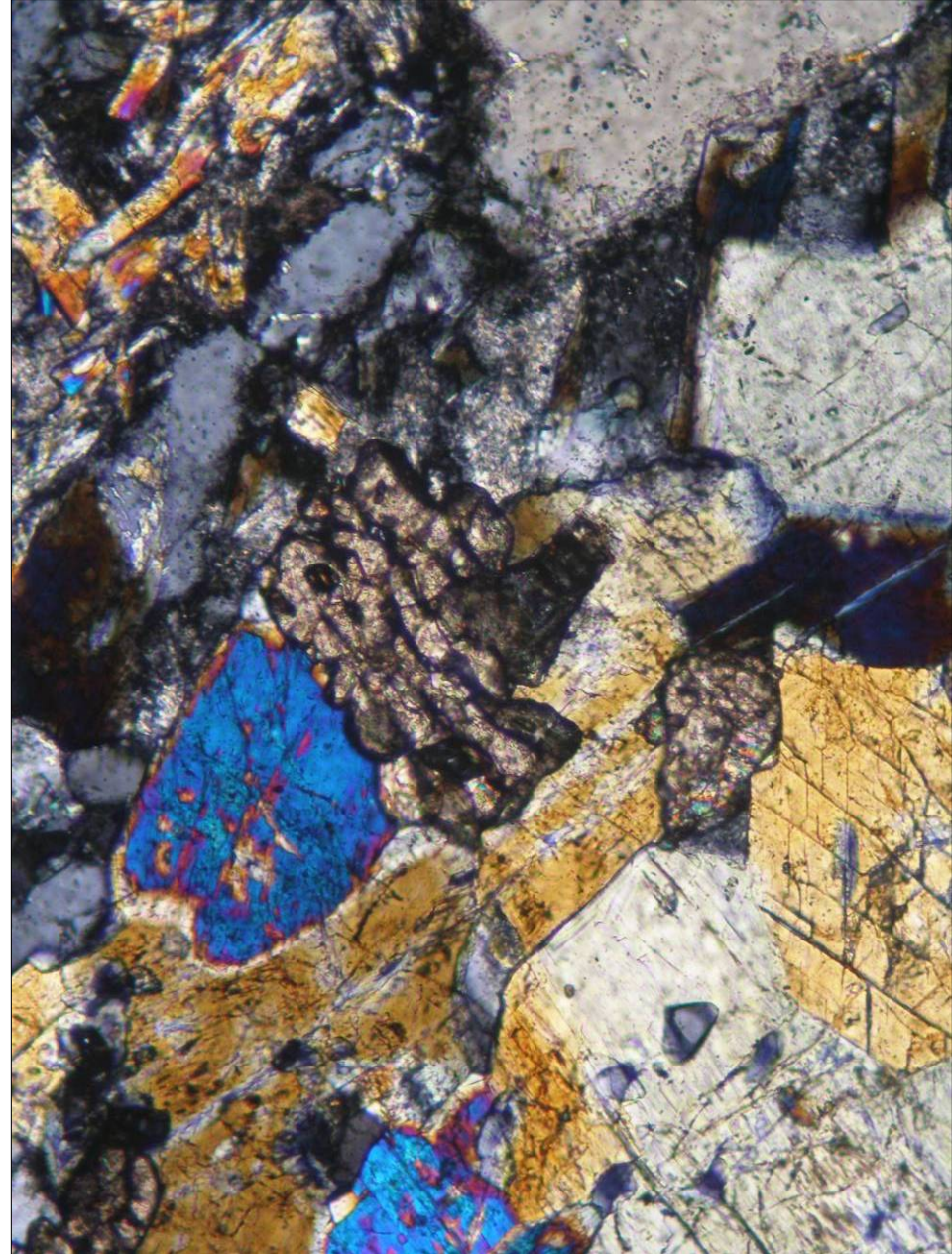
Titanite and diopside-hedenbergite in pegmatite from Žulová, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 2.1 mm. Photo: JiZi.



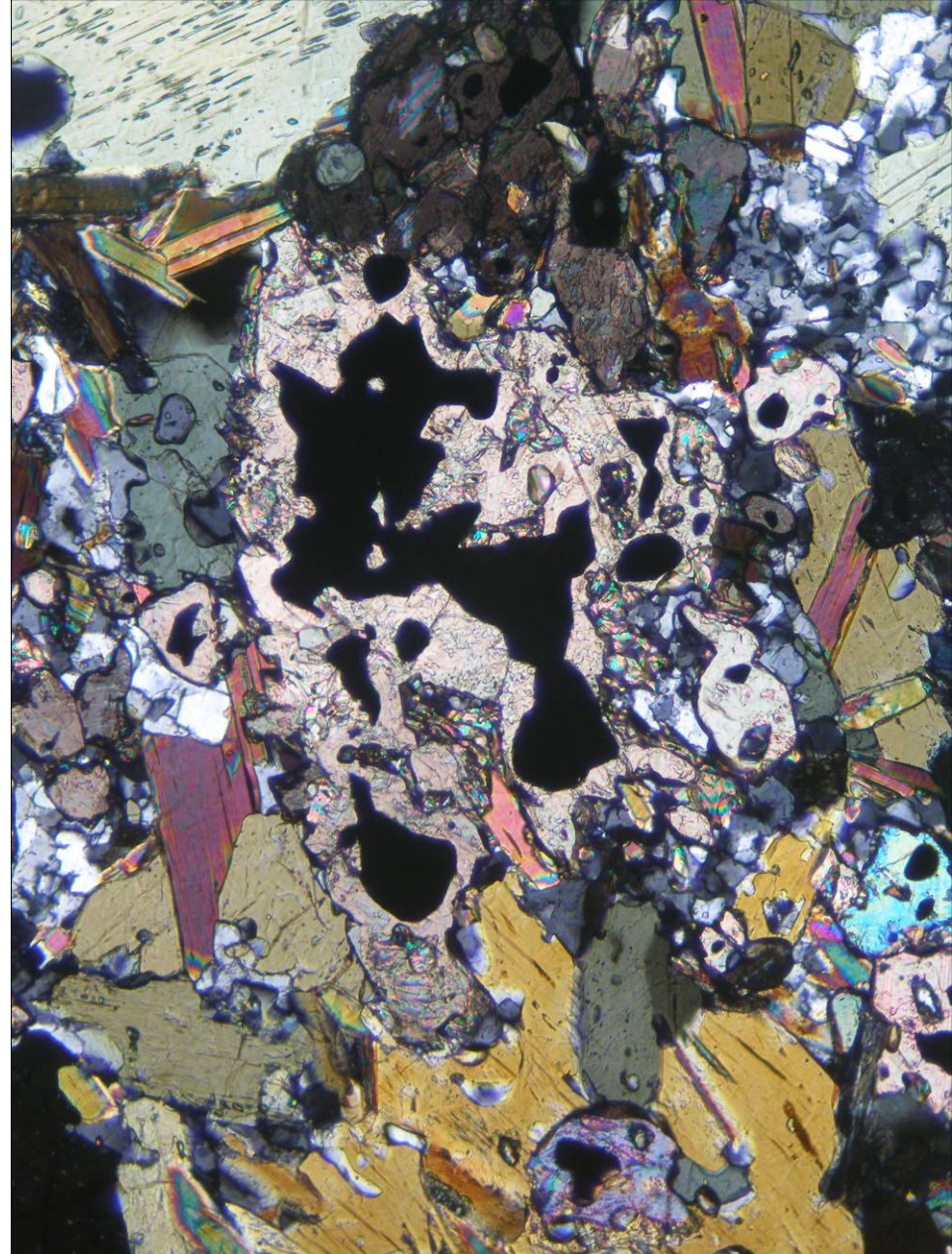
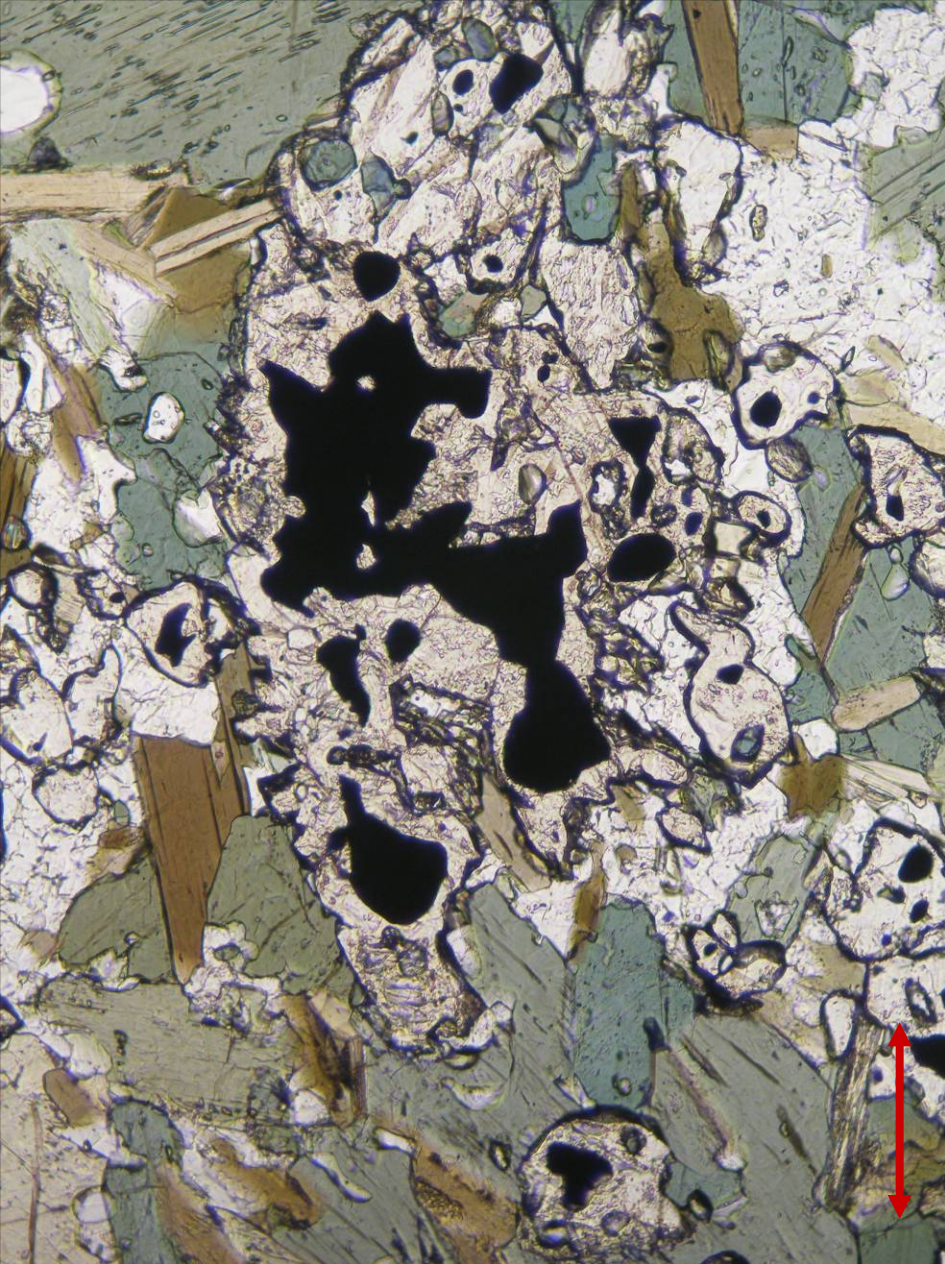
Titanite in garnet amphibolite from Libodřice, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 1.5 mm. Photo: JiZi.



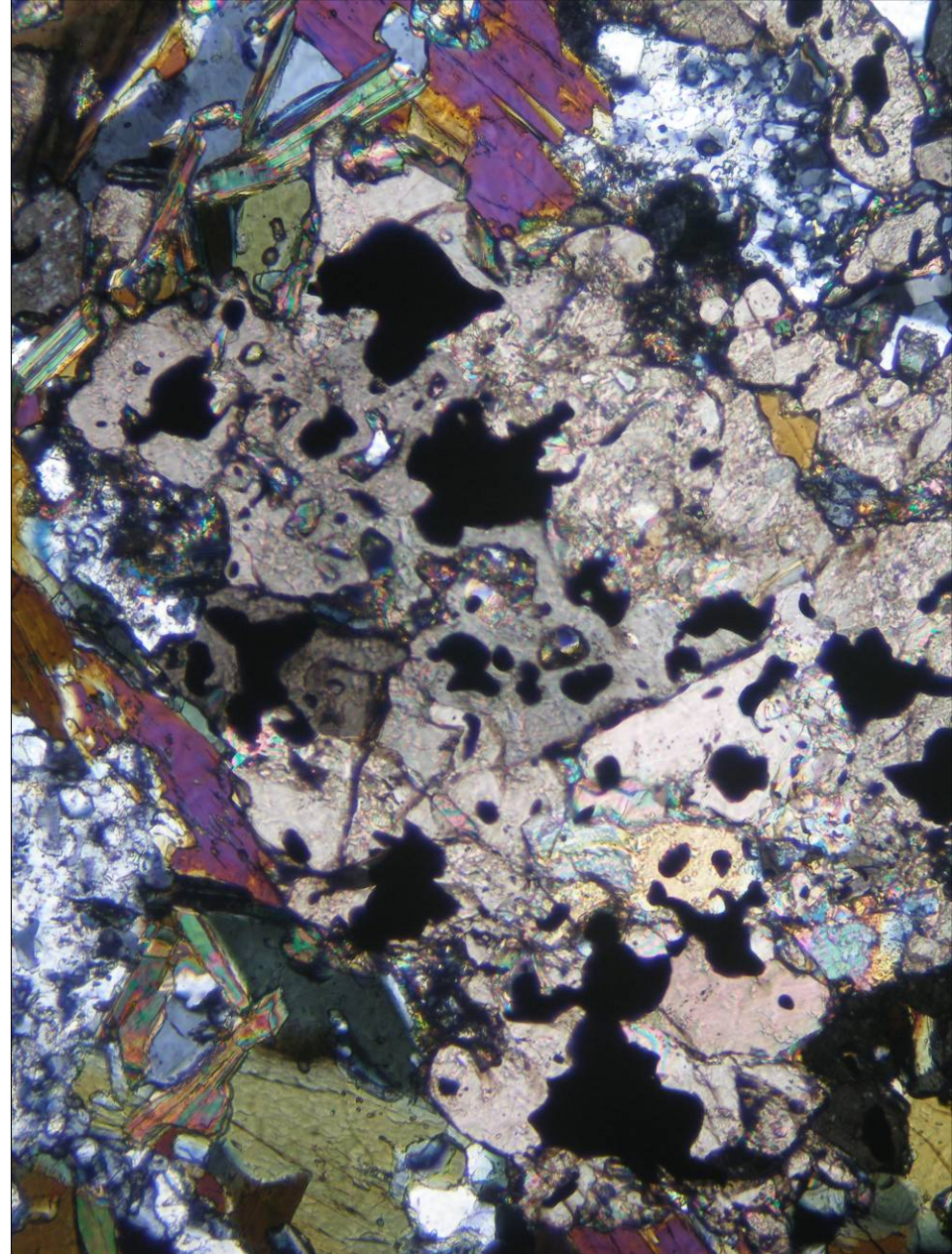
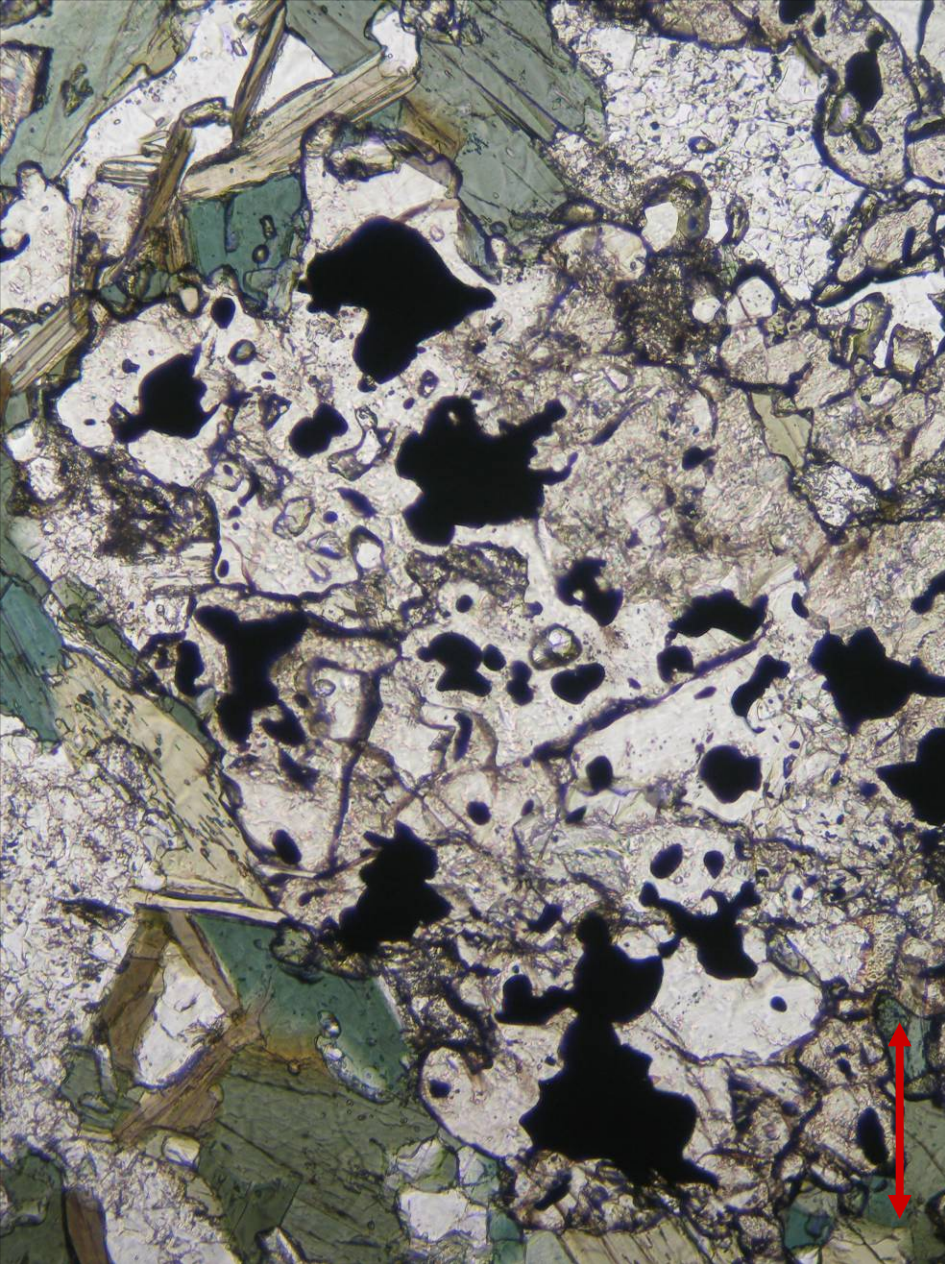
Titanite in garnet amphibolite from Mohelno, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 2.0 mm. Photo: JiZi.



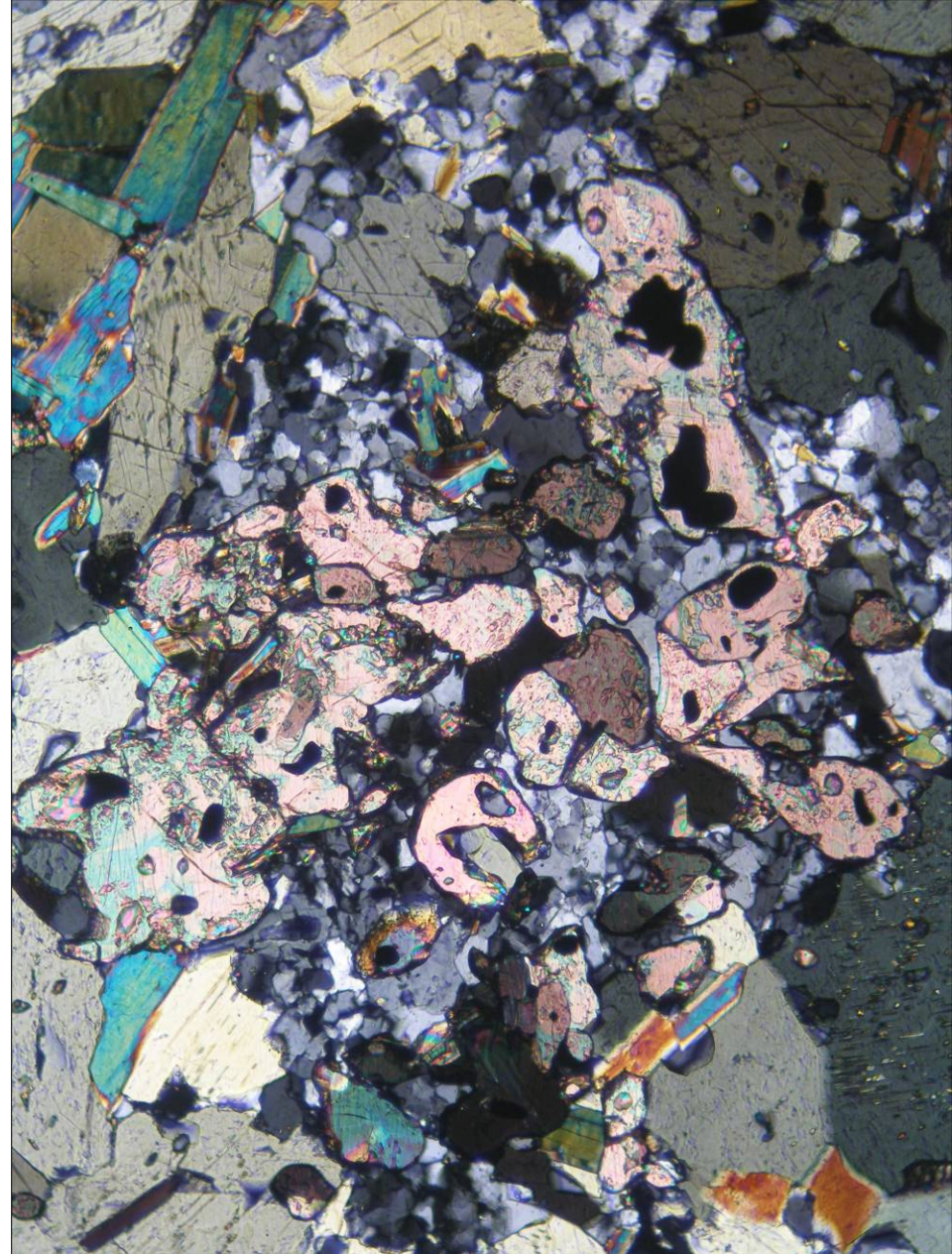
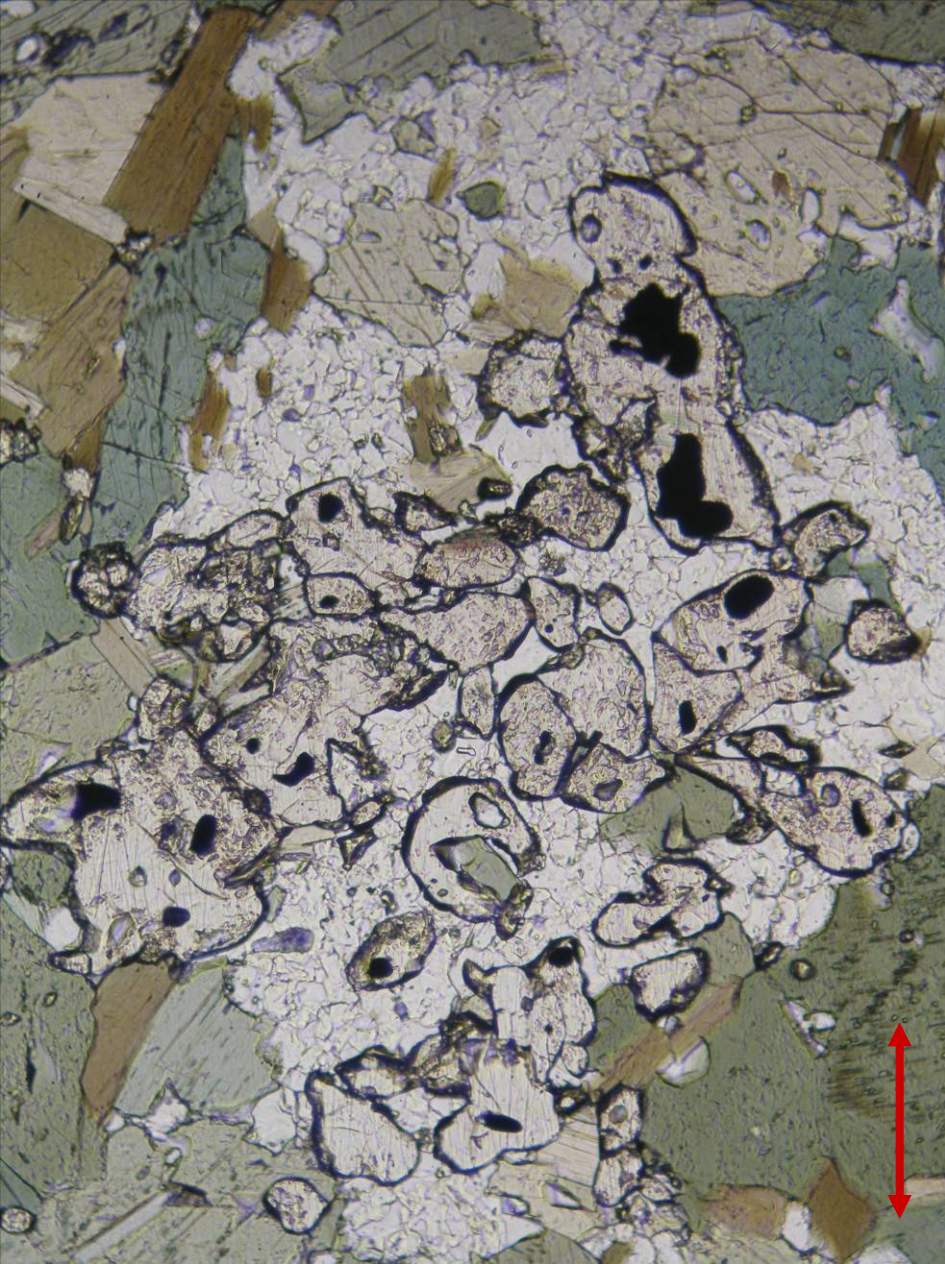
Titanite in garnet amphibolite from Petříkov, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 0.6 mm. Photo: JiZi.



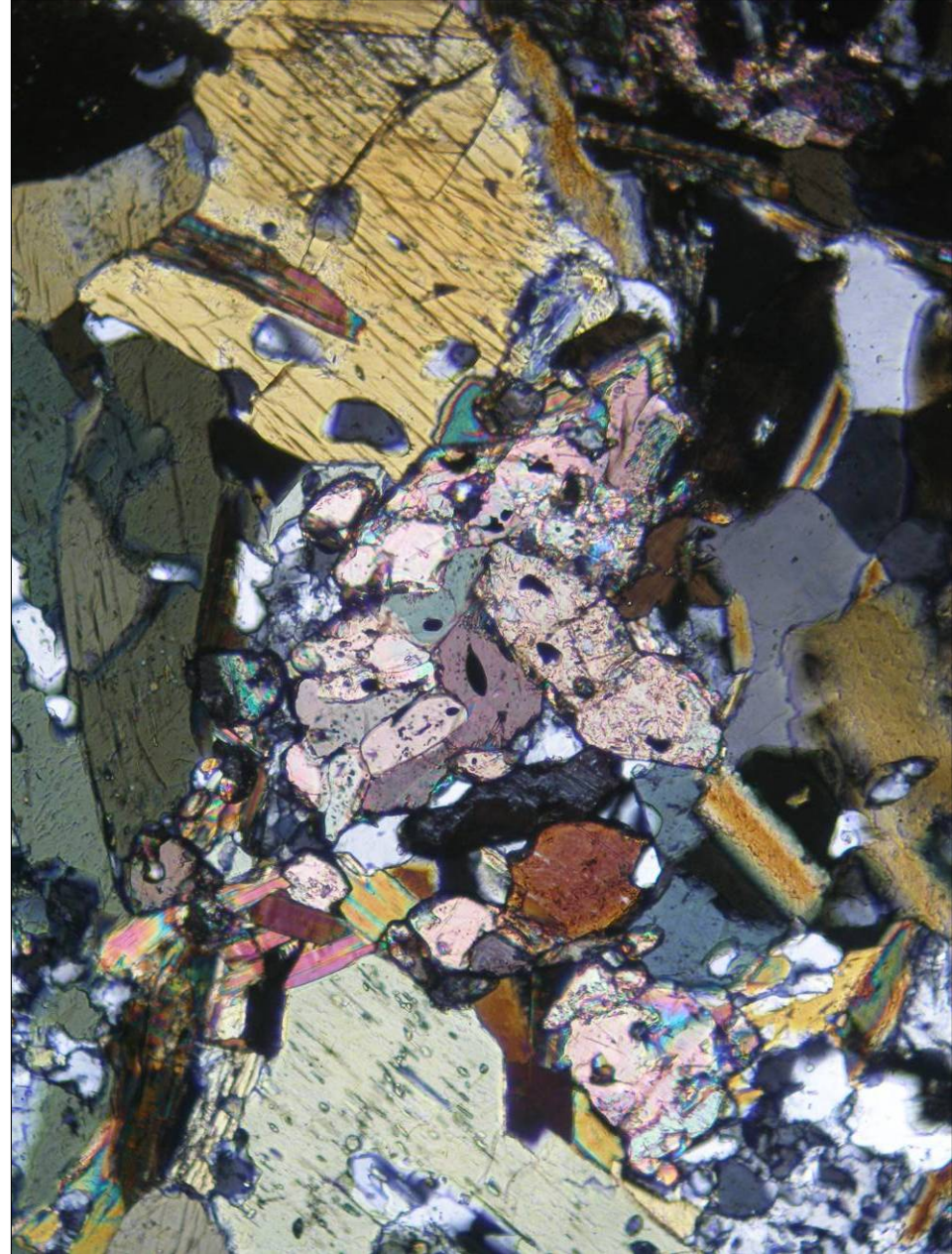
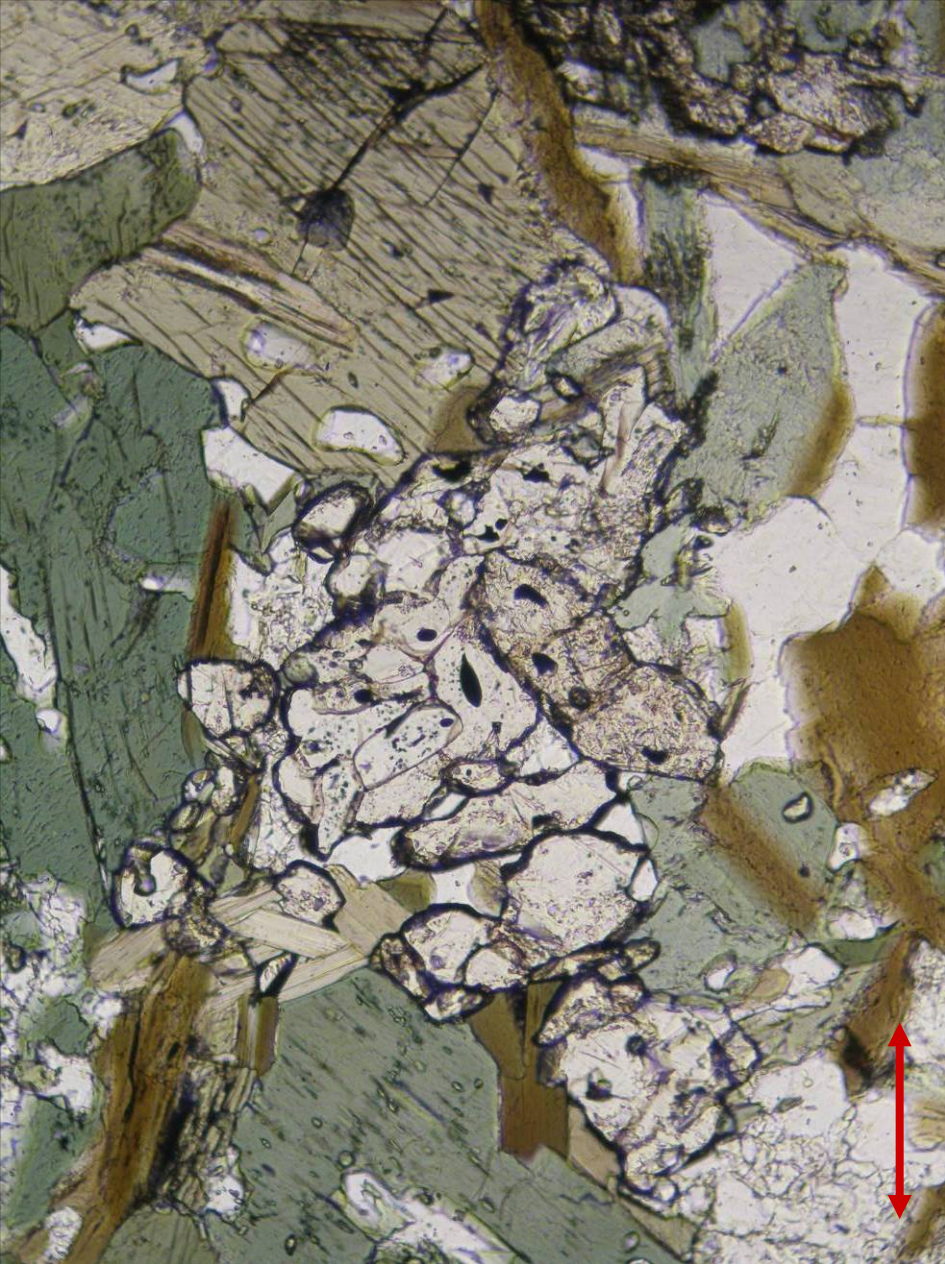
Titanite and ilmenite in amphibolite from Přemyslov, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 0.7 mm. Photo: JiZi.



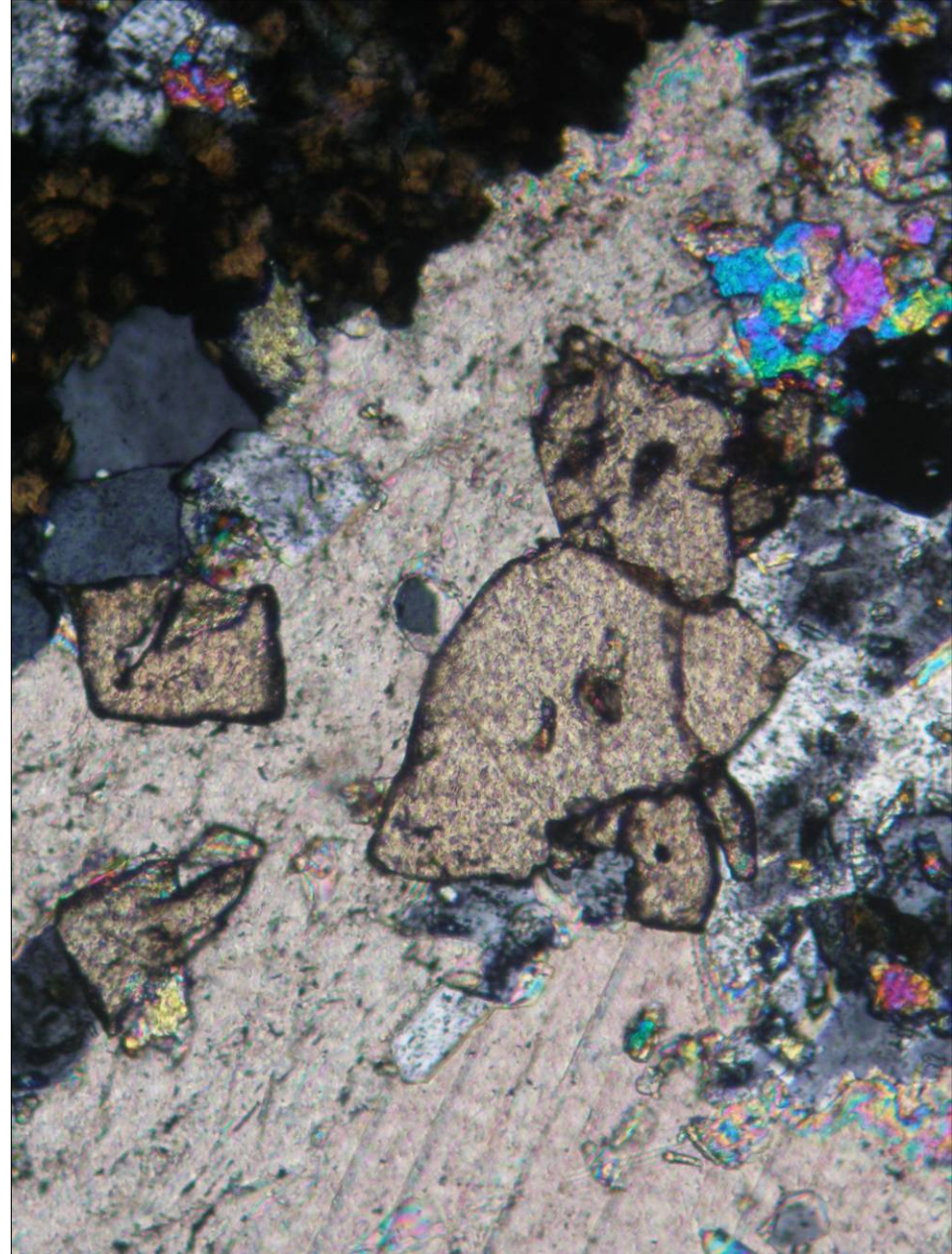
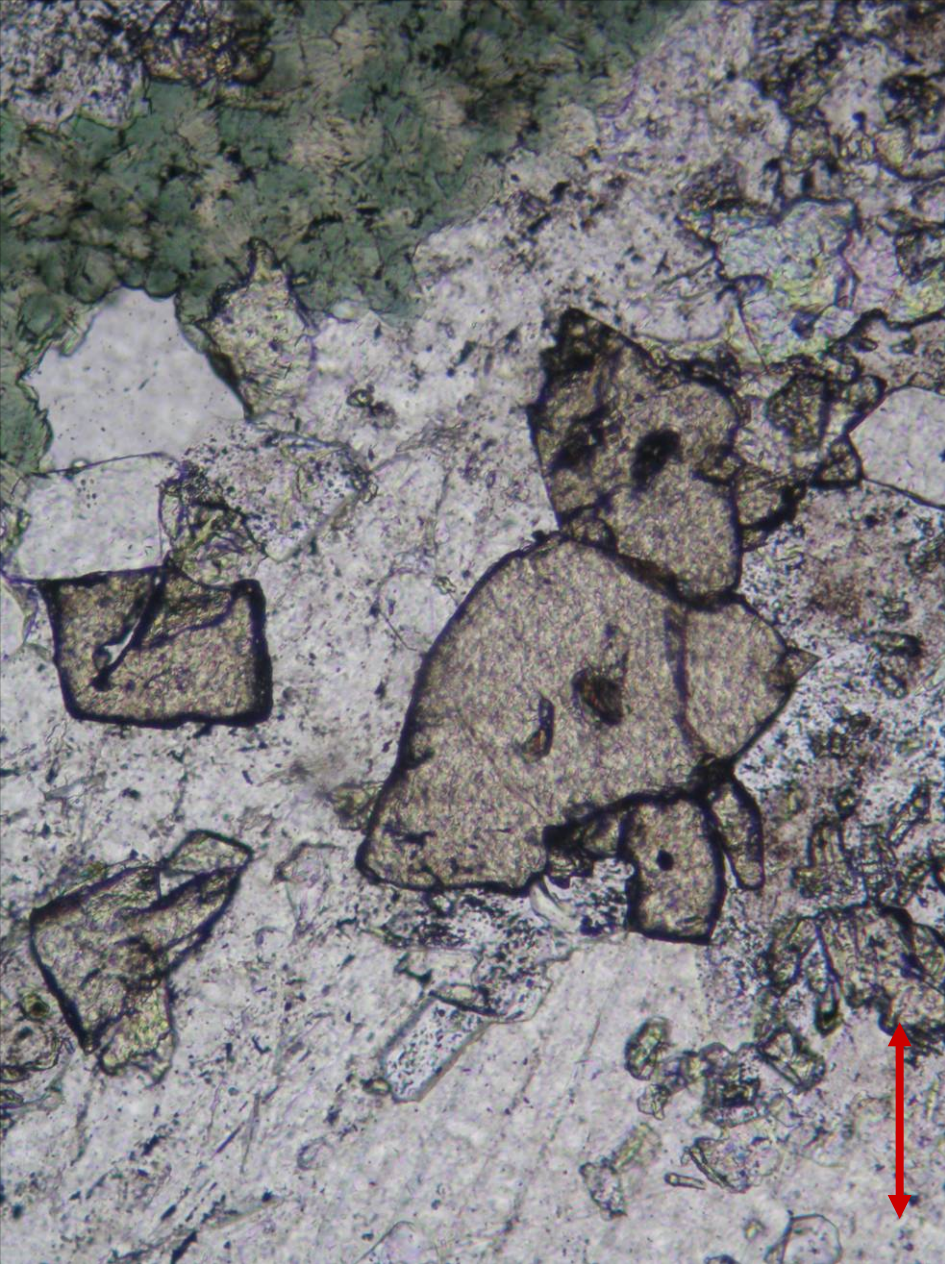
Titanite and ilmenite in amphibolite from Přemyslov, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 0.7 mm. Photo: JiZi.



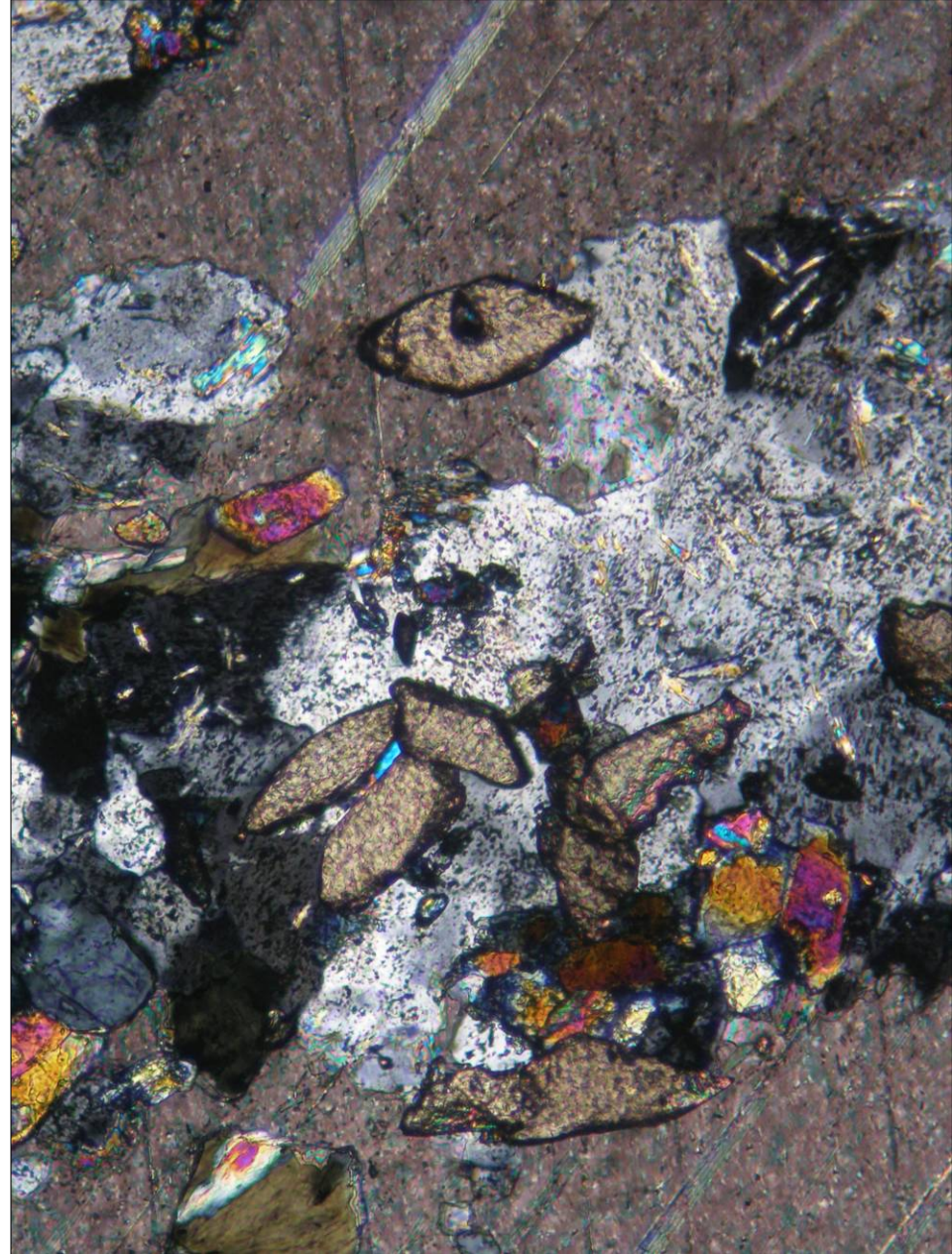
Titanite in amphibolite from Přemyslov, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 0.7 mm. Photo: JiZi.



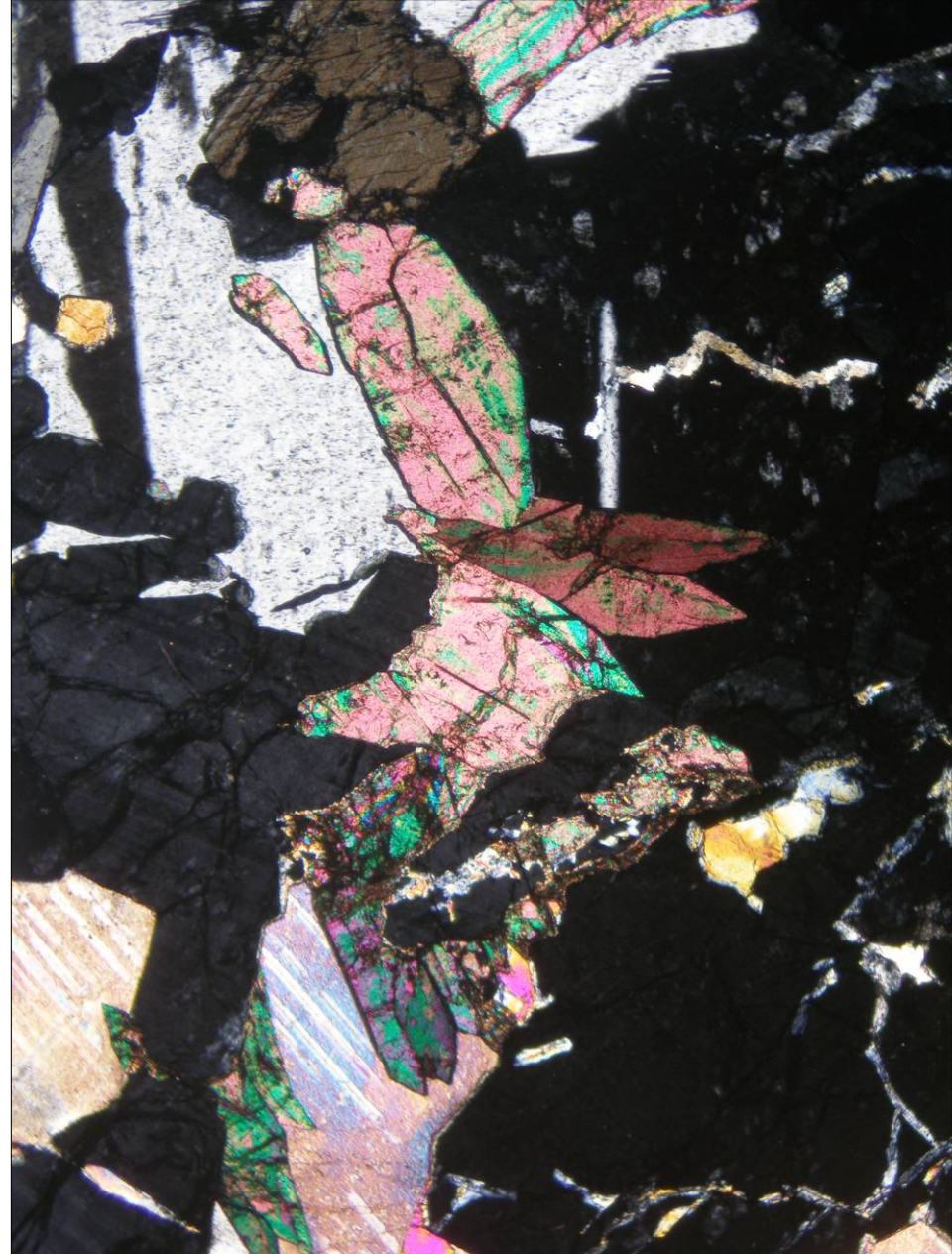
Titanite in amphibolite from Přemyslov, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 0.7 mm. Photo: JiZi.



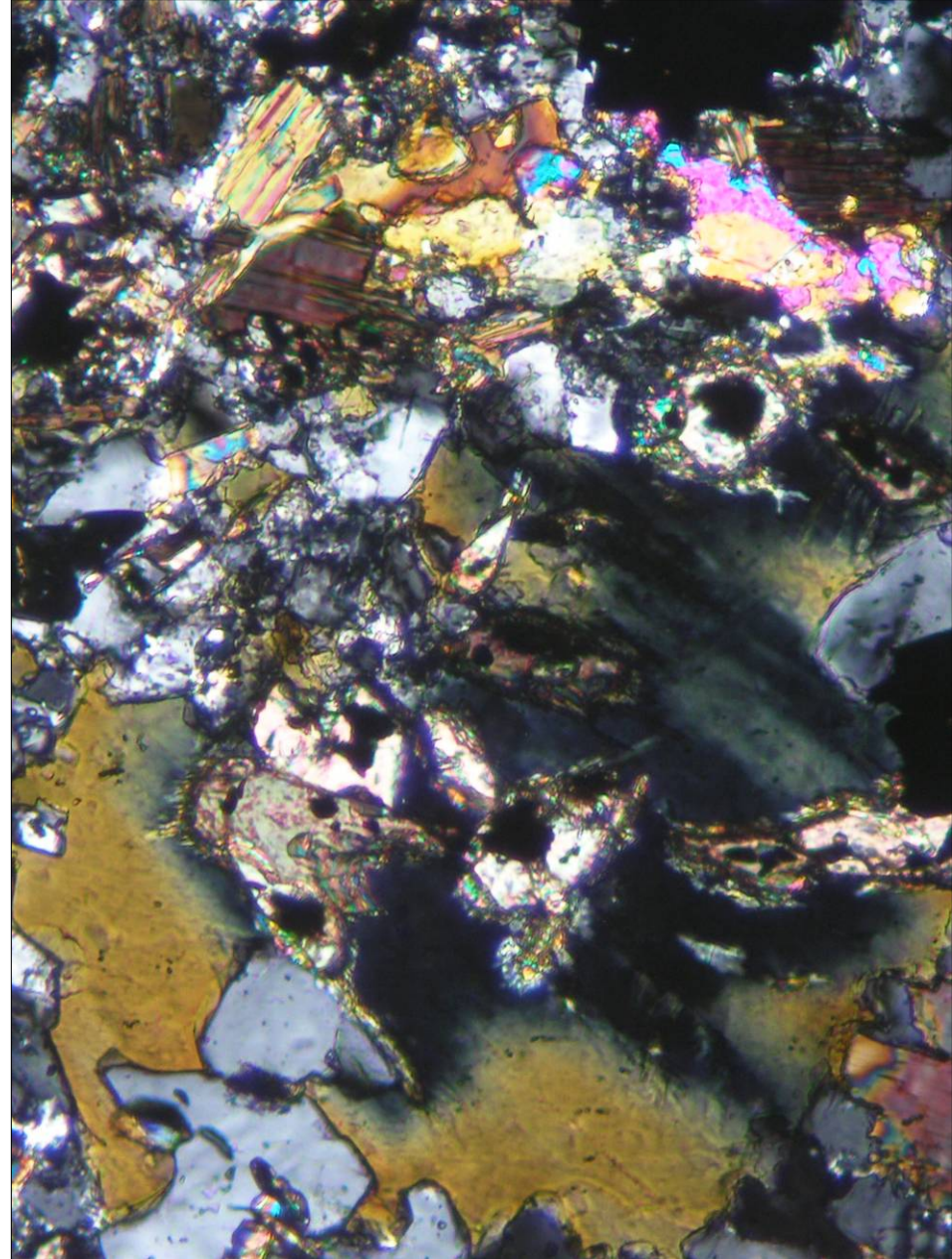
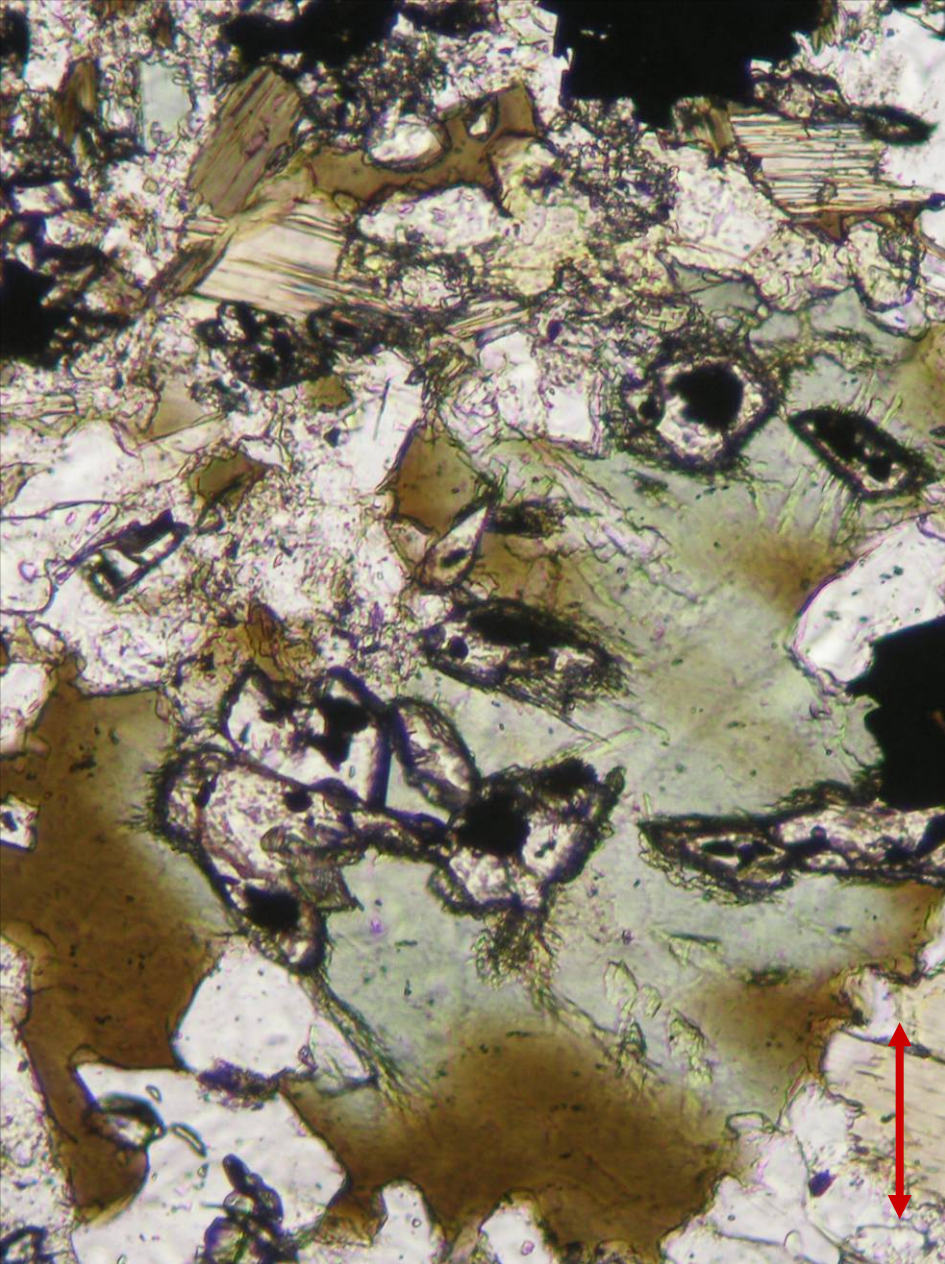
Titanite with calcite, epidote, chlorite and quartz in the Alpine-type vein from Krásné near Hraběšice, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 0.6 mm. Photo: JiZi.



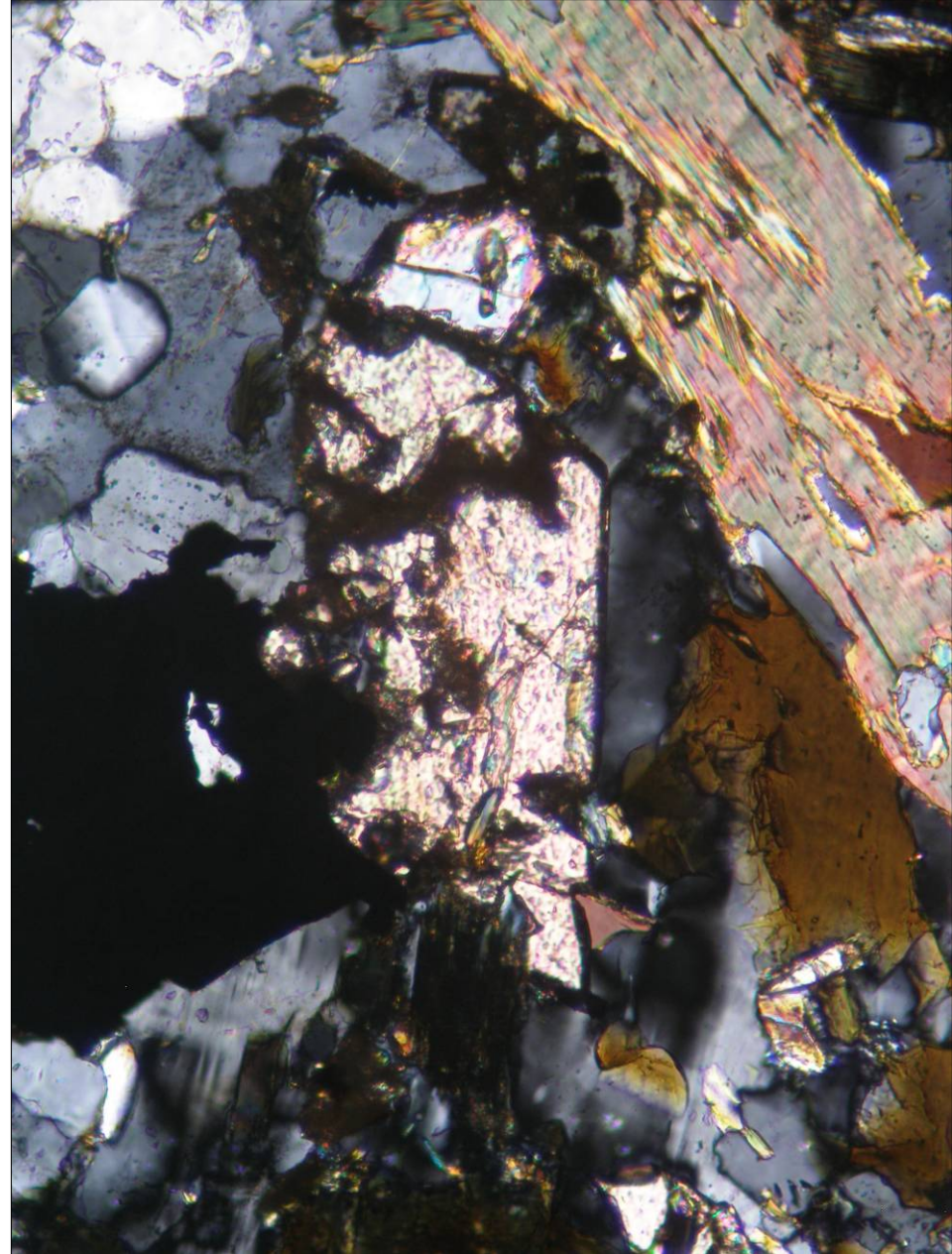
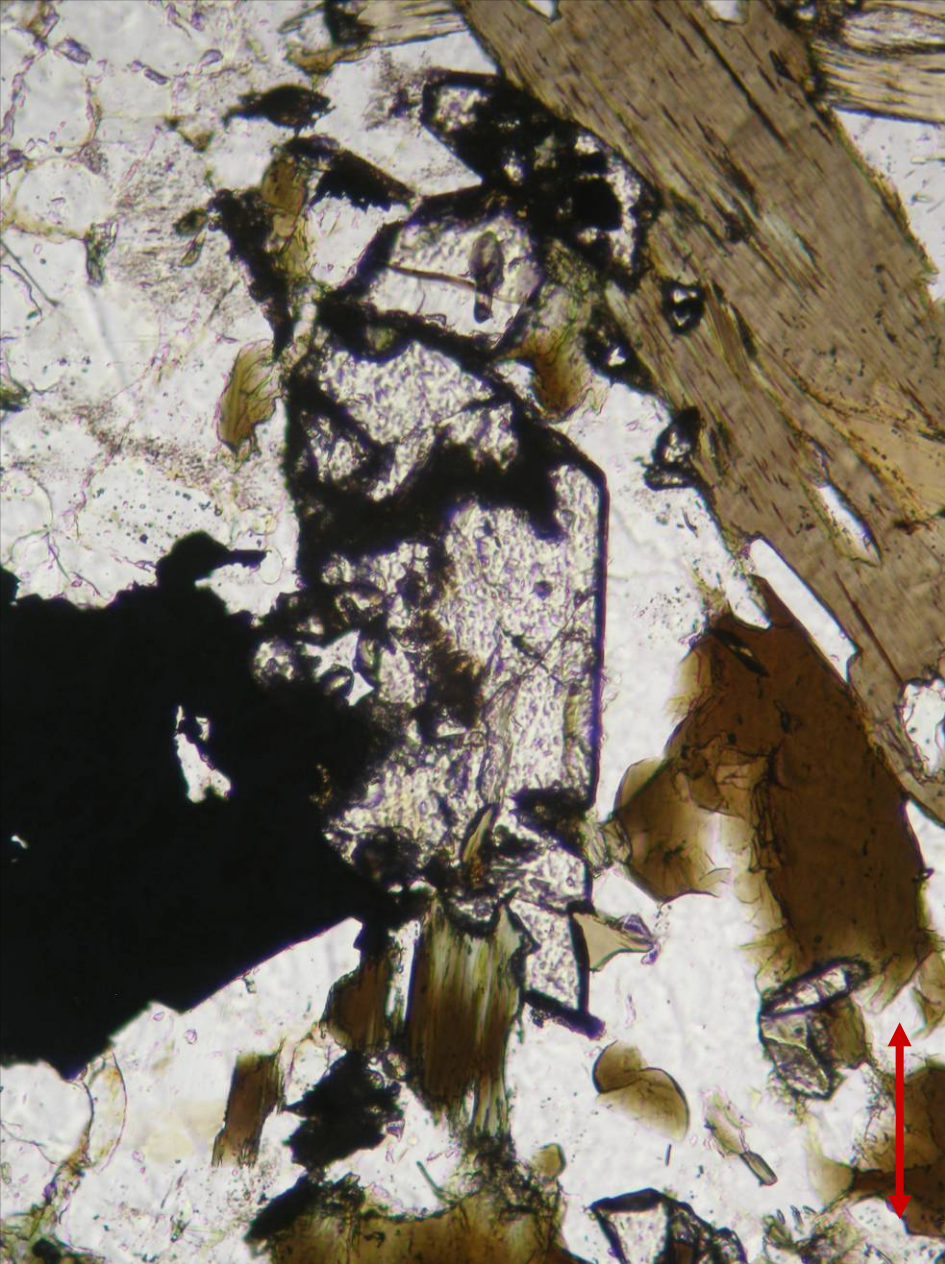
Titanite, calcite, feldspar, chlorite and epidote in a hydrothermal vein of the Alpine-type from Krásné near Hraběšice, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 0.7 mm. Photo: JiZi.



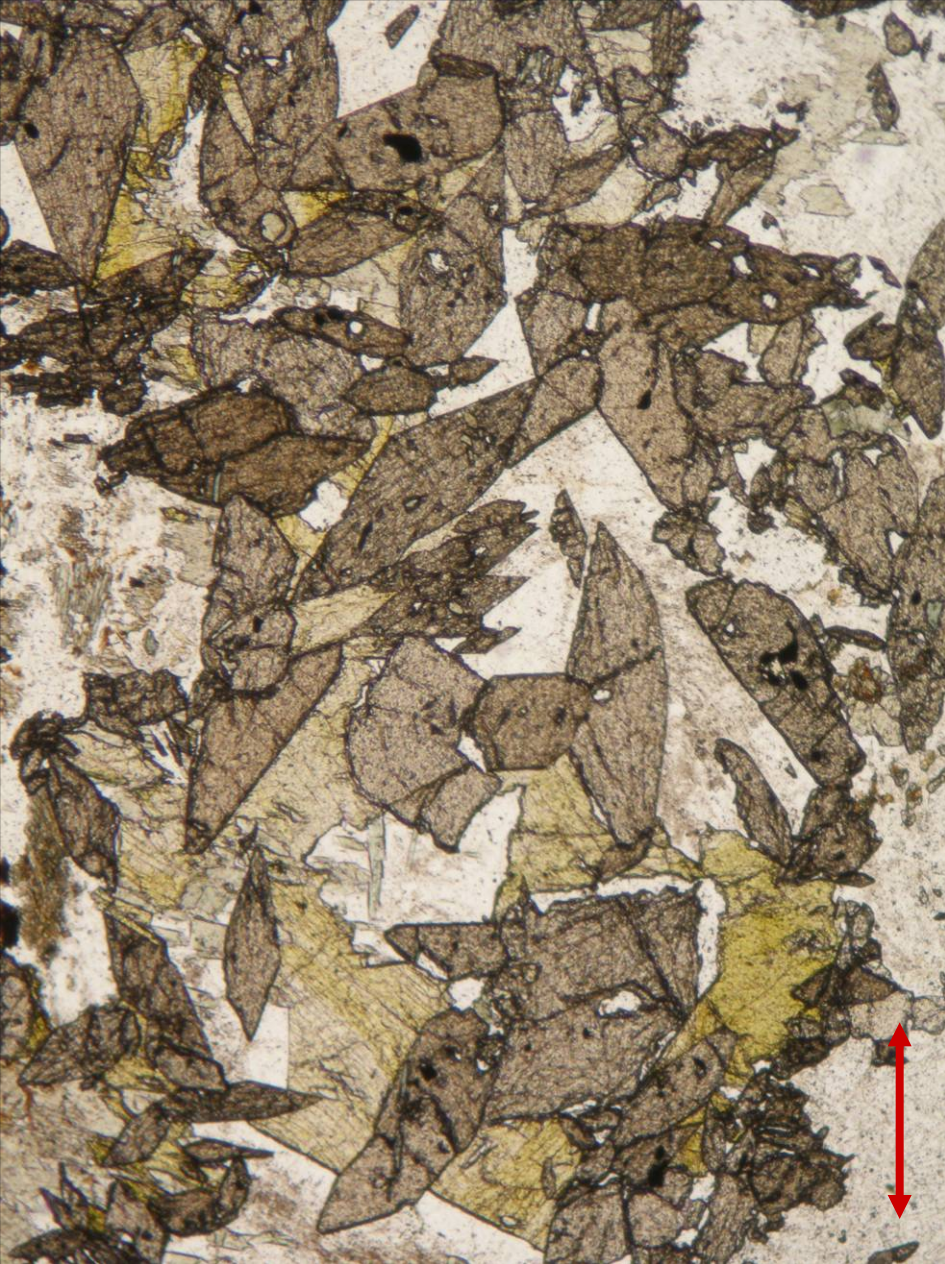
Titanite, garnet, plagioclase and calcite in contact skarn from Žulová, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 1.7 mm. Photo: JiZi.



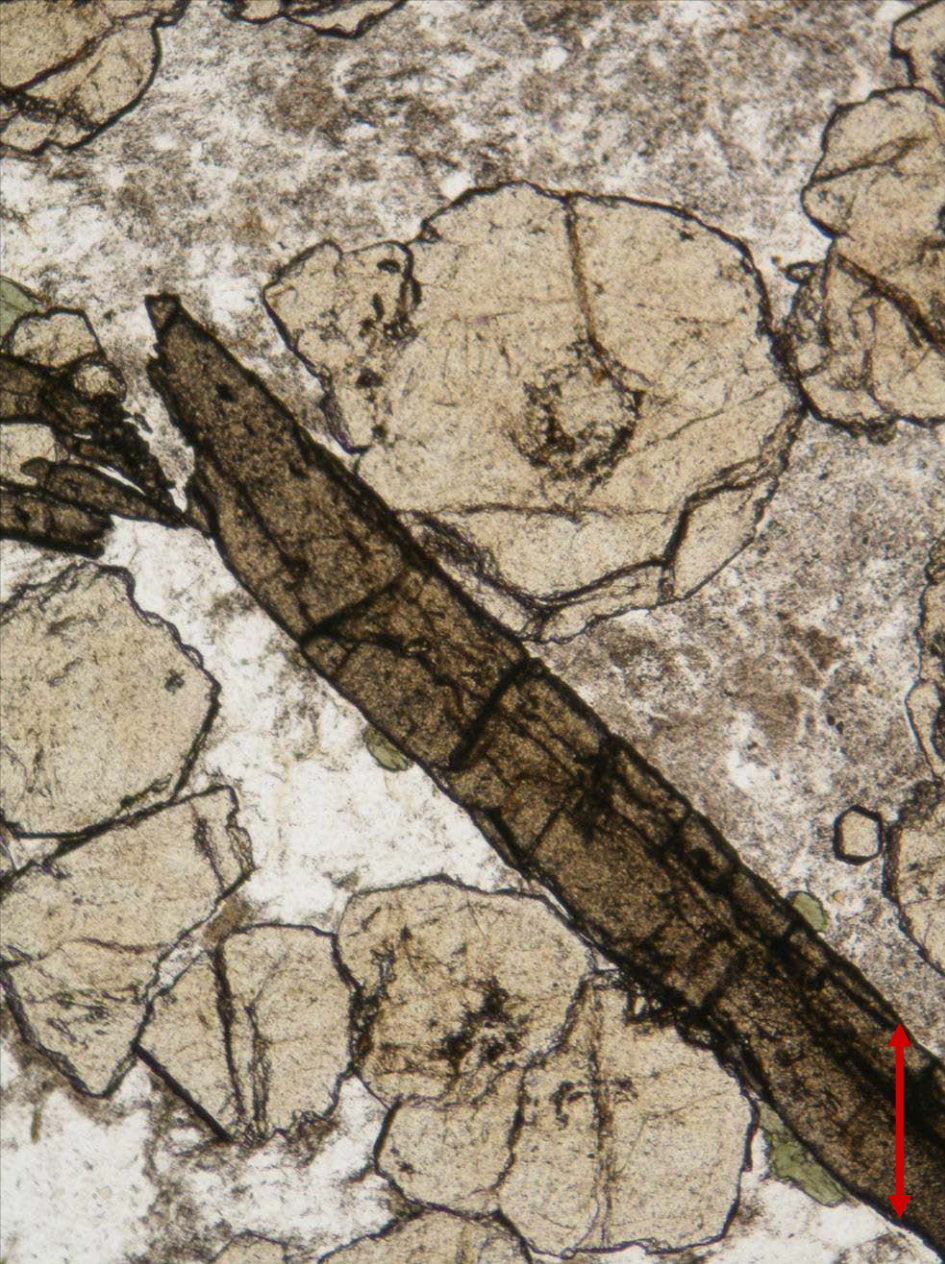
Ilmenite rimmed with titanite in metabasite from Seč, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 0.4 mm. Photo: JiZi.



Titanite in metabasite from Seč, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 0.7 mm. Photo: JiZi.



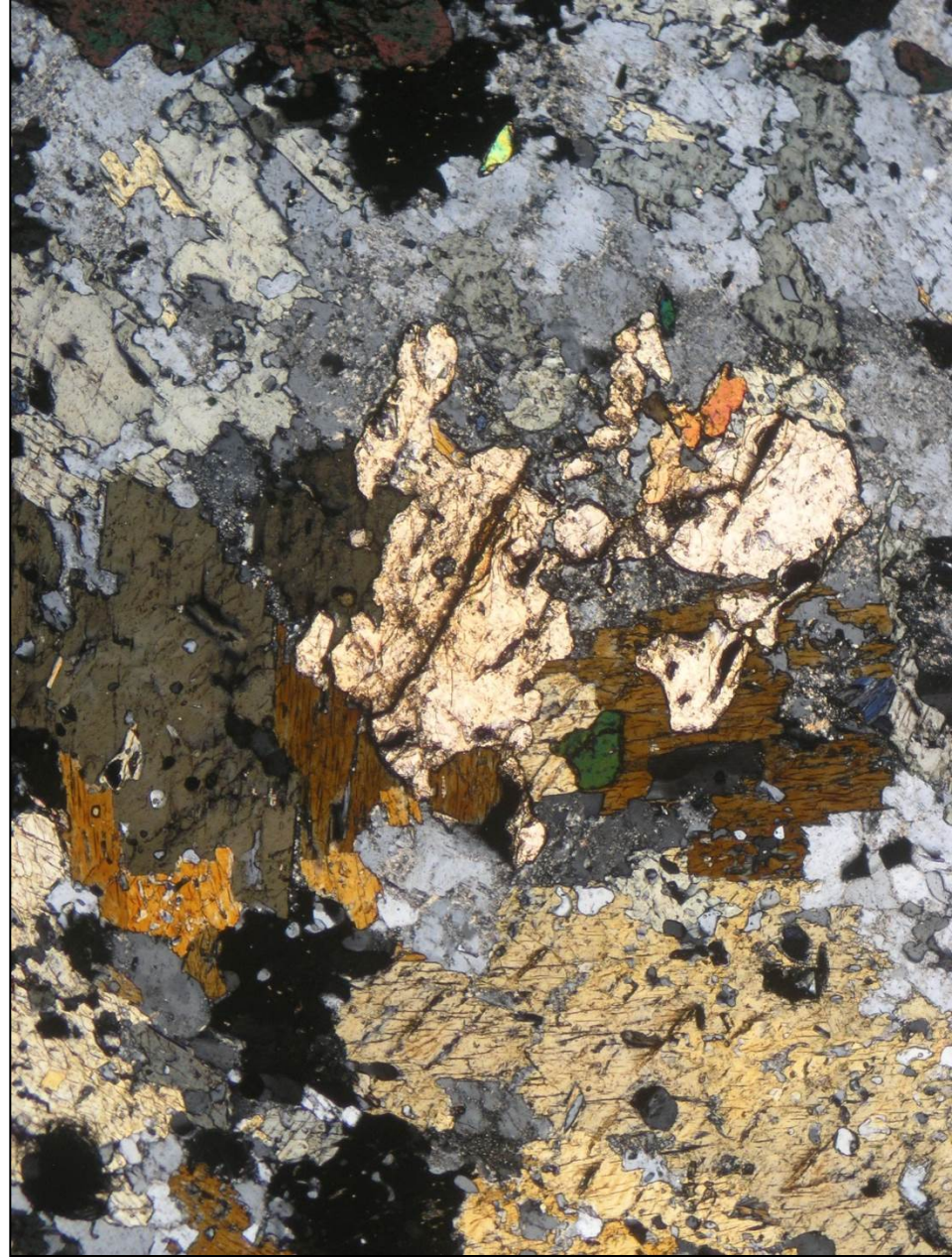
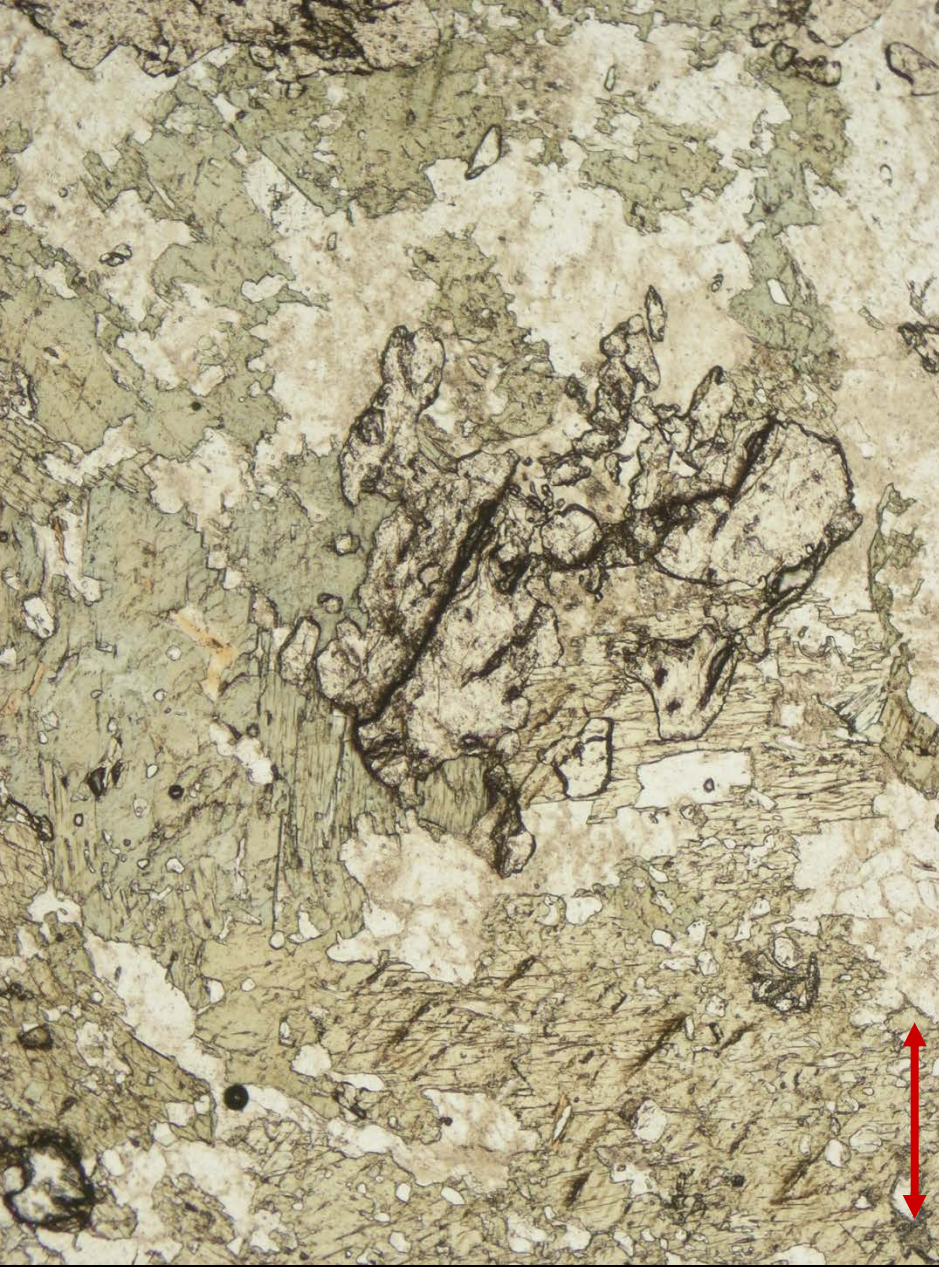
Titanite and epidote in the Alpine-type vein from Vernířovice, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 1.8 mm. Photo: JiZi.



Titanite and garnet in metamanganolite from Vernířovice, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 2.0 mm. Photo: JiZi.



Titanite, garnet, calcite and quartz in skarn from Mirošov, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 1.6 mm. Photo: JiZi.



Titanite in amphibole gneiss from Horní Hoštice, the Czech Republic; PPL (left) and XPL (right). Width of fields of view is ca. 2.4 mm. Photo: JiZi.