PLATES

PLATE I

a. Isoclinal folds in mica schists near San Finx. Narrow quartz-rich bands and folds (F_1) underwent a second deformation by F_2 as well as nearby fault movements. The older structures (F_1) have been obliterated in the mica-rich parts of the sample (St. 141682).

b. A banded albiteblast-bearing paragneiss (s_1) showing traces of a second deformation (s_2). Negative print: the micas are white and the albites dark (St. 141692).

c. Thin section of a weakly banded paragneiss (F_1) in which a weak second schistosity (s_2) is visible. A tourmaline vein sub-parallel to s_1 has also been folded by F_2. Negative print: tourmaline vein and micas are white, quartz and plagioclase are dark (St. 141691).

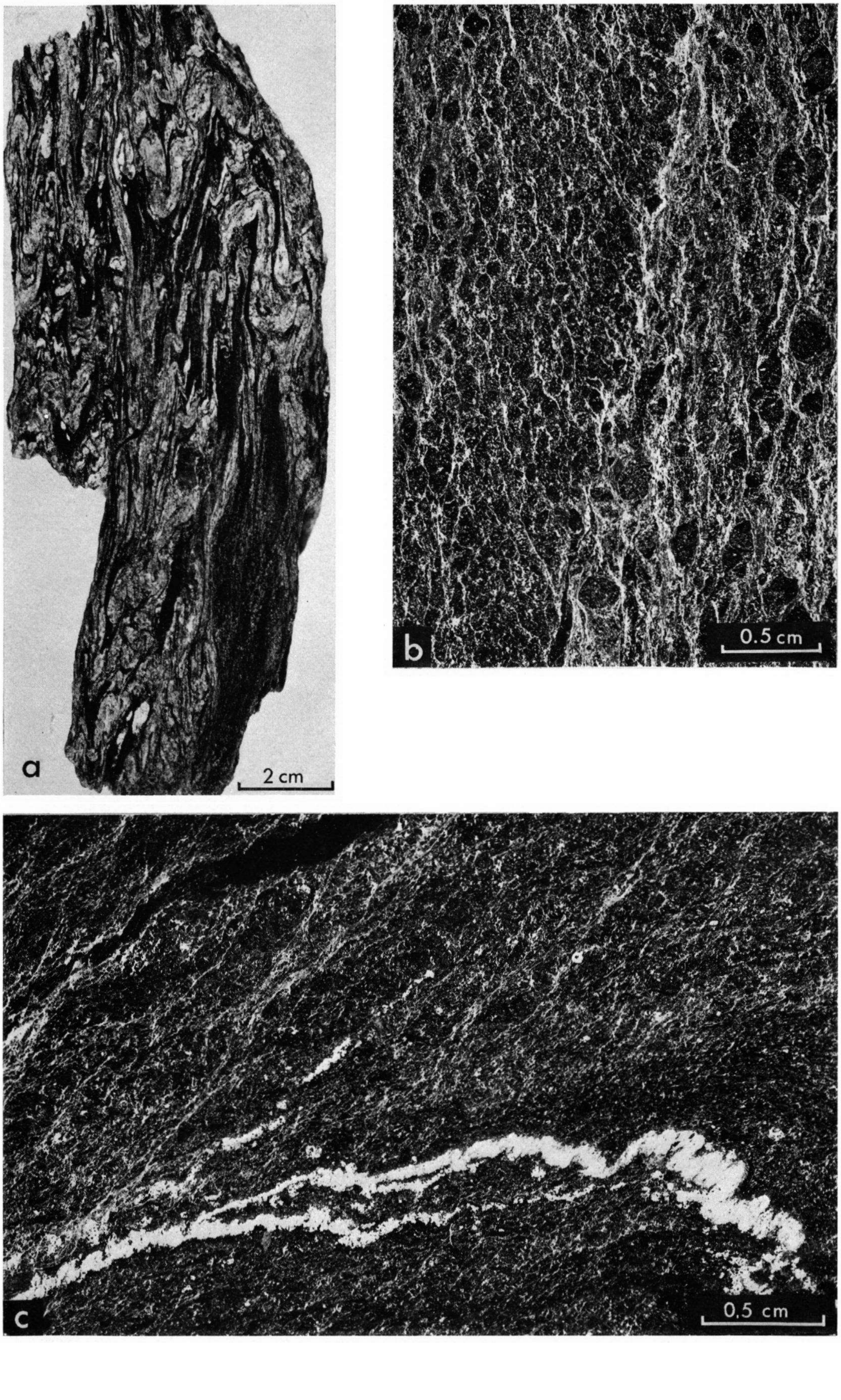

a
2 cm
b
0.5 cm
c
0.5 cm

PLATE II

a. Twinned oligoclase metablast, enclosing small quartz droplets, resorbed garnet and opaque minerals in metablastic paragneiss 1 km WSW of Pte. Beluso.
b. An untwinned oligoclase metablast enclosing relatively large as well as some smaller quartz grains and a few micas; location 700 m ENE of Noya.
c. A twinned albite metablast with quartz grains (s_i) in parallel alignment in an albiteblast-bearing paragneiss 600 m WSW of Val.

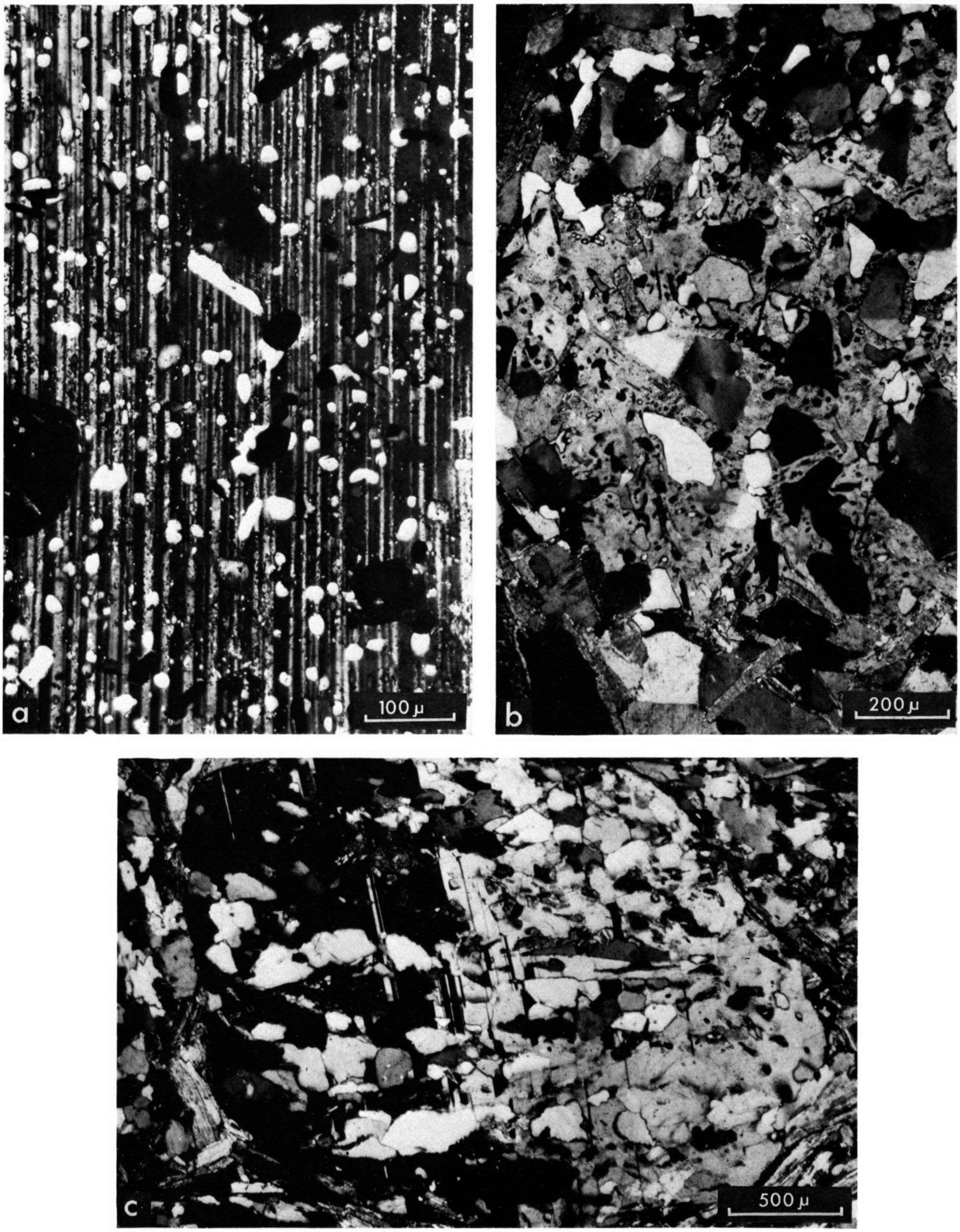

a
100 μ
b
200 μ
c
500 μ

PLATE III

a. Linear blastomylonitic biotite orthogneiss; section // lineation (St. 141717).
b. Same sample, section $\perp$ lineation.
c. Planolinear biotite orthogneiss; section $\perp$ foliation (St. 141720).
d. Augen-bearing biotite orthogneiss. Part of the alkali feldspar augen have been completely crushed (Pta. Péon).
e. Partly mobilized biotite orthogneiss (St. 141790).

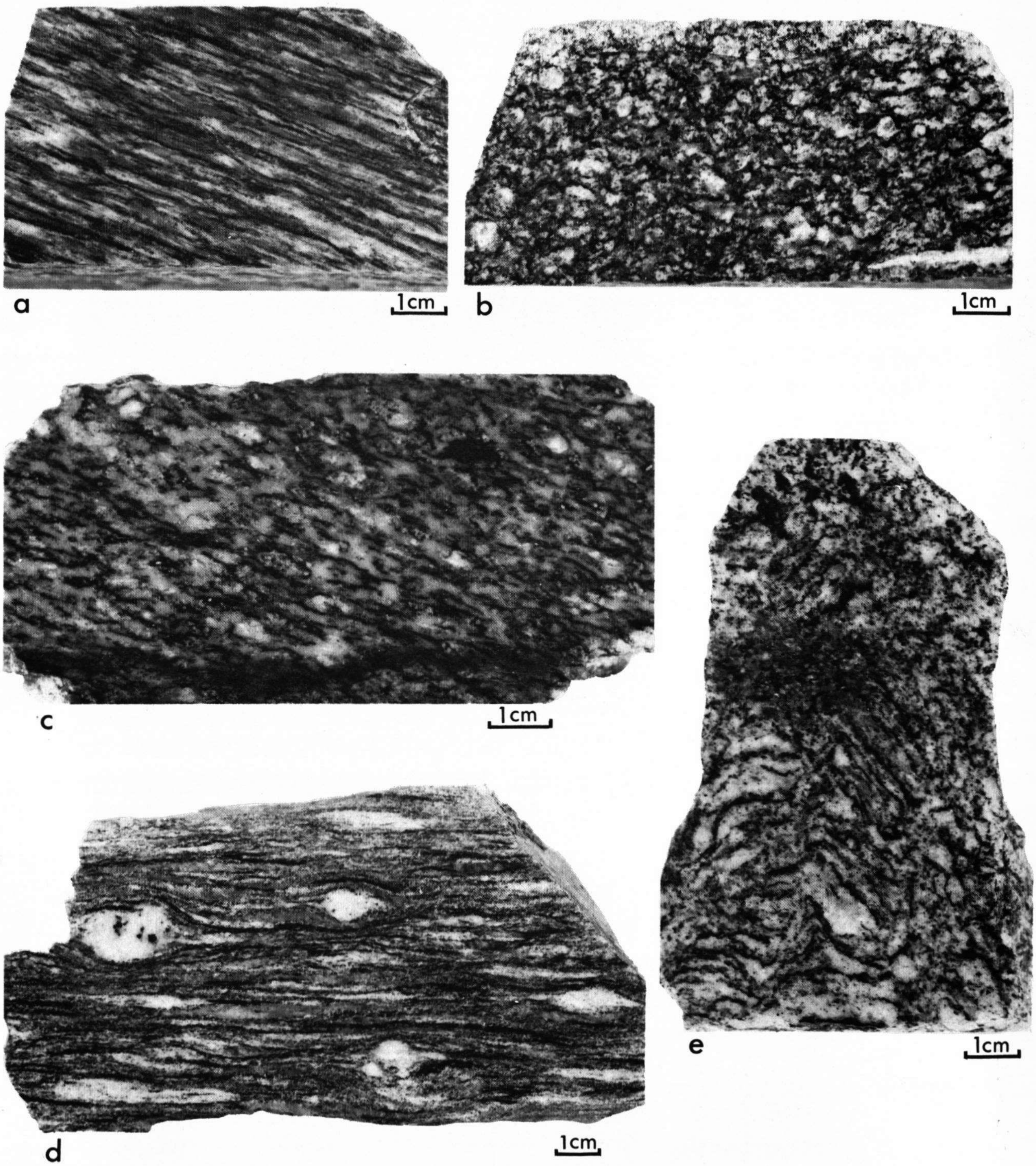

a
1cm
b
1cm
c
1cm
d
1cm
e
1cm

PLATE IV

a. Linear blastomylonitic biotite orthogneiss; photomicrograph (crossed nicols) of thin section // lineation. Quartz is highly recrystallized (post-F_3; mosaic or polygonal); the micas occur mainly in the microcrystalline mortar zones (white streaks). Negative print (St. 141717).
b. Thin section photomicrograph of the same sample $\perp$ lineation. The recrystallized quartz aggregates are more coarsely grained than the feldspar aggregates. Negative print.
c. Thin section photomicrograph of an ortho-amphibolite displaying a metaporphyritic structure. The isometric relics are plagioclase aggregates which may often enclose biotites (St. 141745).
d. Photomicrograph of an ortho-amphibolite (St. 141745) with a metaporphyritic structure (hornblende clusters).

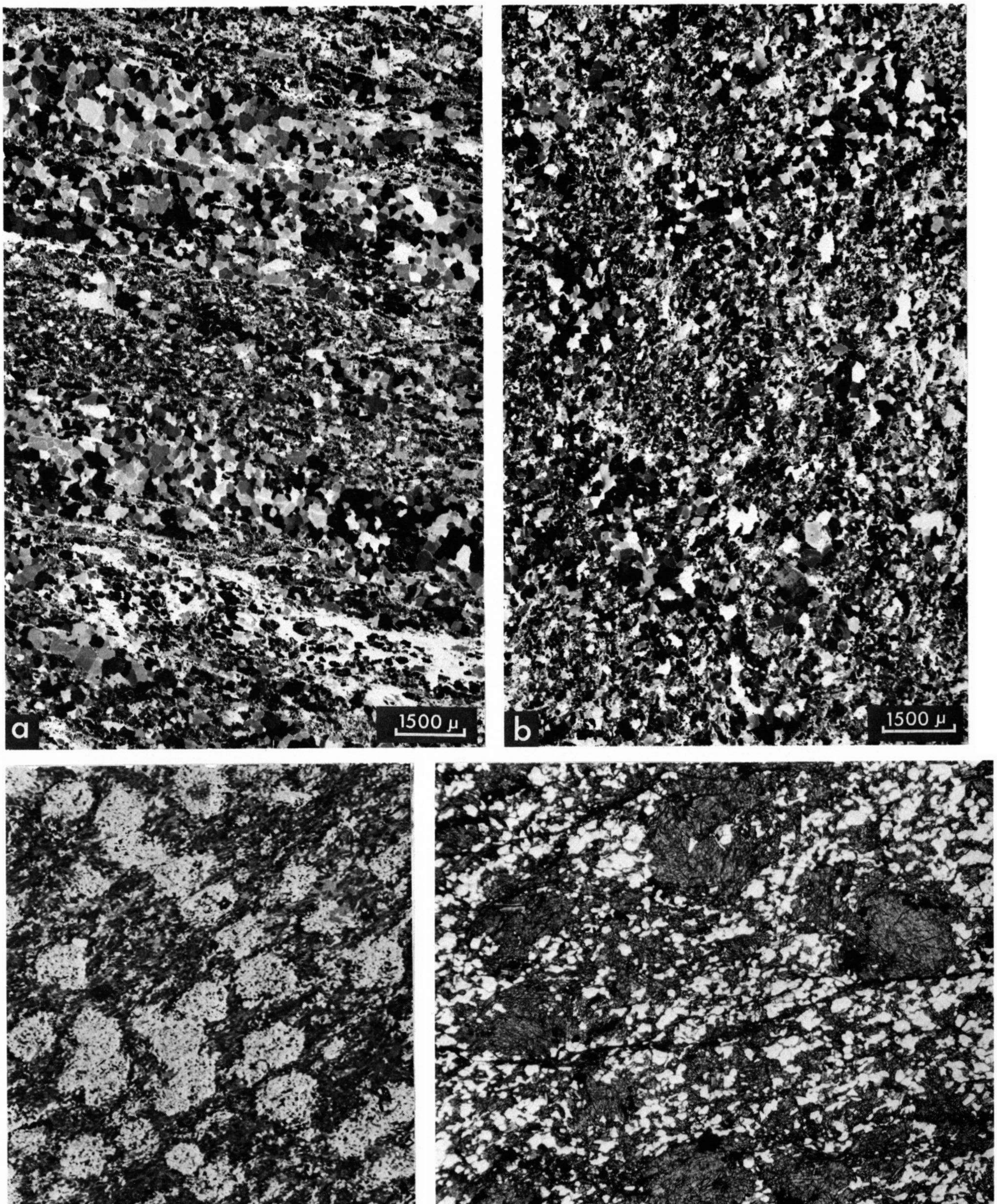

a
1500 μ
b
1500 μ
c
500 μ
d
1000 μ

PLATE V

a. A finely banded (s_1) muscovite-chlorite-bearing metaquartzite deformed by F_2, resulting in a sub-vertical crenulation cleavage. A few large post-kinematic (with respect to F_2) andalusite crystals have grown in the crenulation cleavage planes. Negative print: micas and andalusite are greyish or white; quartz is dark (St. 141703).
b. An isoclinal F_1-fold in a graphite schist enclosing traces of pre-F_1 (F_0?) folds in the crests. Negative print: graphite is white and quartz is dark (St. 141707).
c. Albite metablast (aggregate) with a folded s_i (St. 141712).

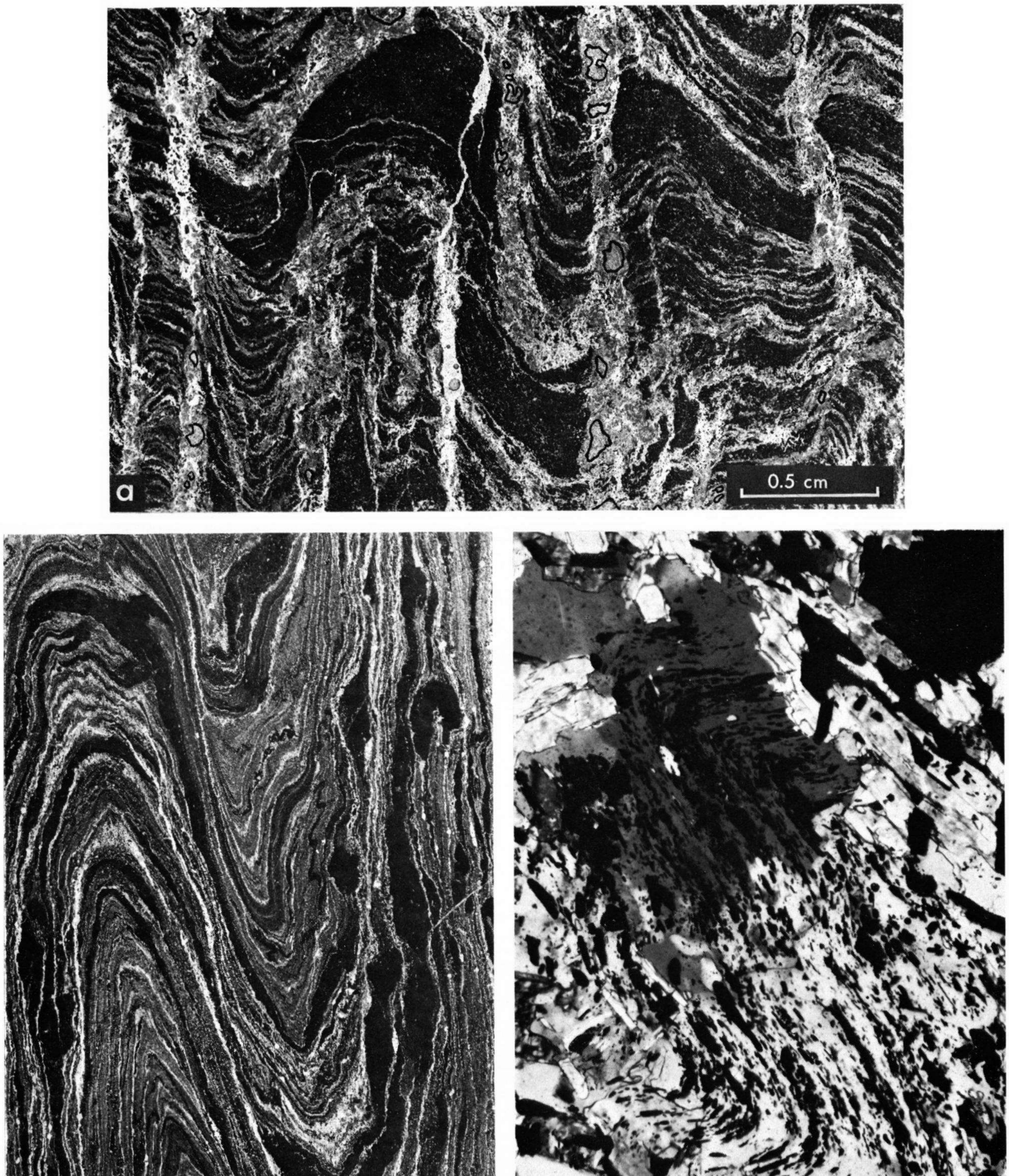

a
0.5 cm
b
0.5 cm
c
50 μ

PLATE VI

a. Migmatite with a banded structure (metatexite); the metatect consists of quartz and some plagioclase. Biotite has recrystallized in the melanosome where it borders the metatect (St. 141766).

b. Migmatite with a folded structure. The metatect has a pegmatitic or granitic composition (St. 141775).

c. Migmatite with a "schlieren" structure. The incoherent melanosome was folded because of the high mechanical mobility of the granitic metatect (location 4.8 km NE of Pte. Beluso).

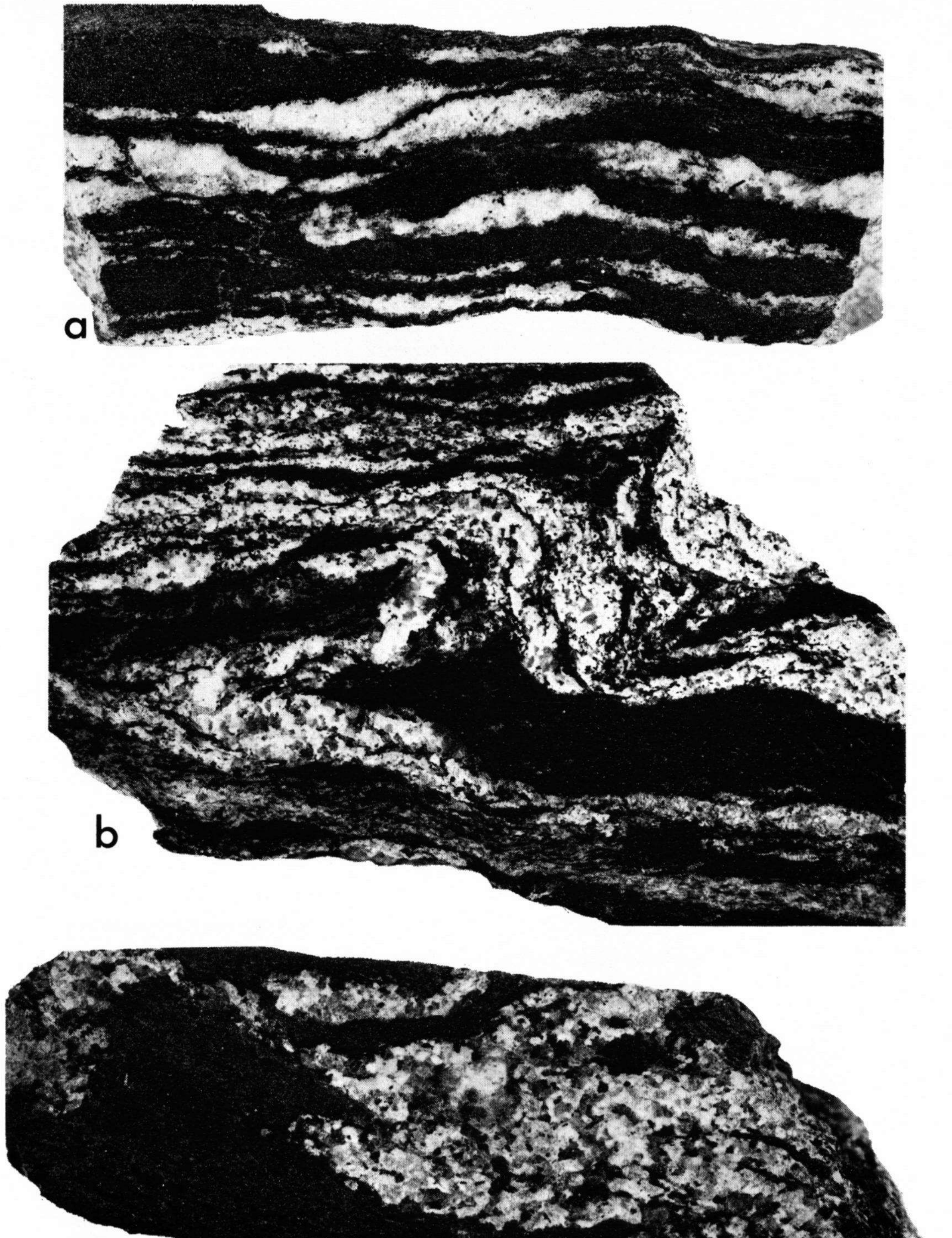
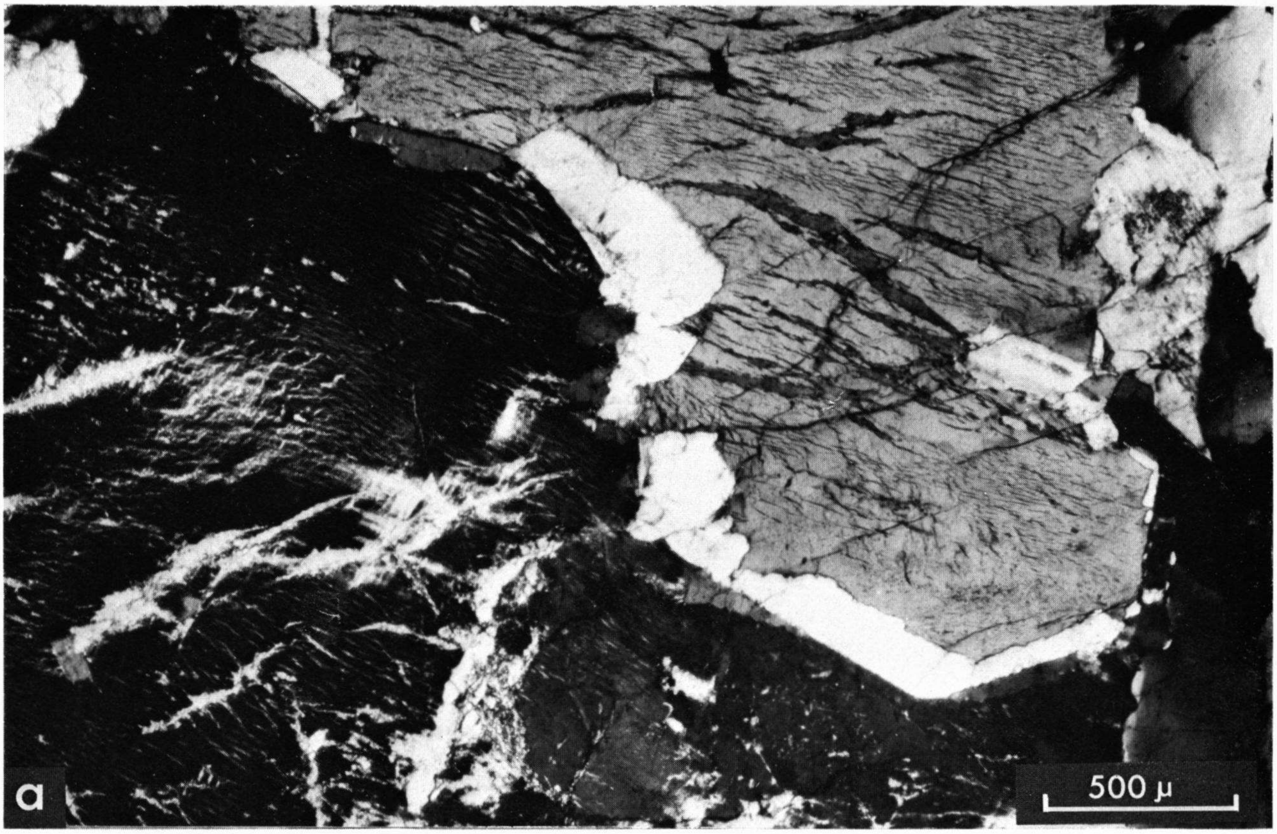

a
b
c
1cm

PLATE VII

a. Alkali feldspars displaying albitization and different types of perthite; granitoid migmatite, 5 km E of Val.

b. Rim of a large alkali feldspar from a coarse-grained augengneiss, 7 km NNW of Esteiro, showing two successive stages during myrmekitization: the fine quartz wormlets close to the alkali feldspar and the recrystallized quartz drops farther away.


a
500 µ

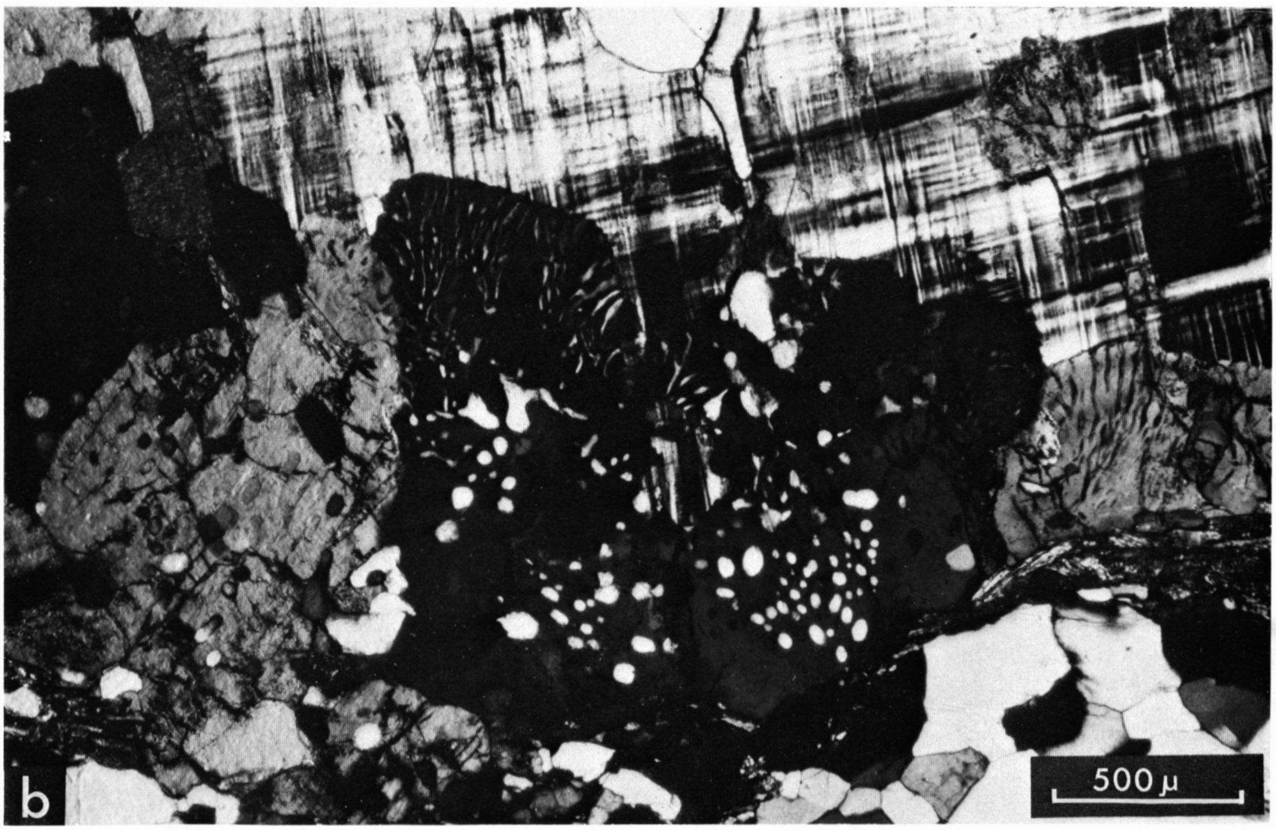

b
500 µ

PLATE VIII

a. Coarse-grained augengneiss with a phyllonitic and partly mylonitic texture, due to a strong tectonization (F_3) after migmatization (St. 141781).
b. Coarse-grained augengneiss after migmatic recrystallization into a very coarse-grained two-mica granite, 2.5 km SE of Esteiro.

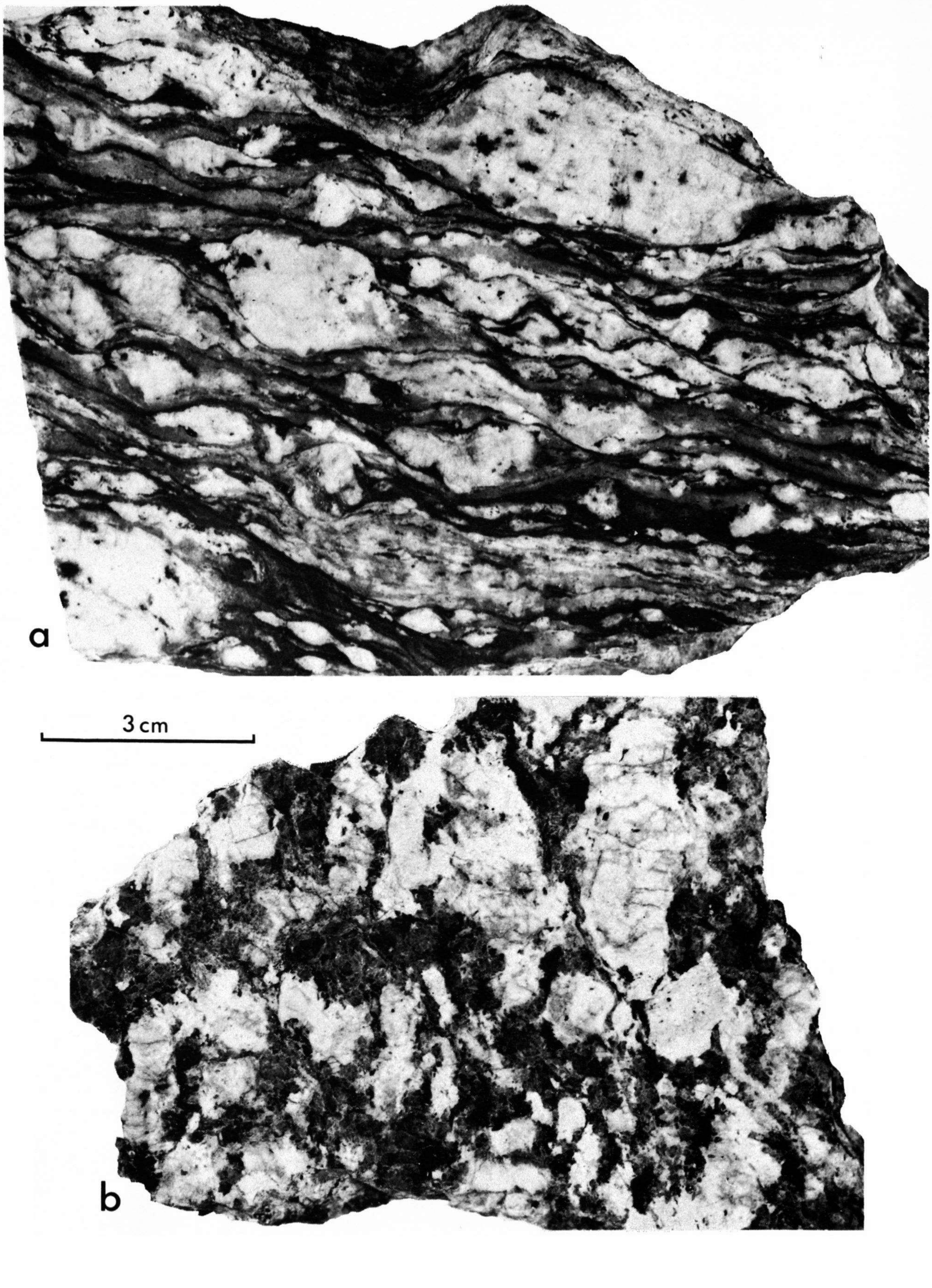

a
3 cm
b

PLATE IX

a. The megacrystal-bearing granodiorite has become a kakyrite as a result of F_3 and fault movements. Most of the quartz has been squeezed out. Mt. Tállara, S of Noya.
b. Photomicrograph (crossed nicols) of a late-stage muscovite in a medium to fine-grained two-mica granite (Muros-type). Phyllonitization (F_3) has affected the granite and the muscovite (St. 141829).
c. A highly deformed two-mica granite near the fault 1 km WSW of Boiro. Quartz has filled up the fractures in the alkali feldspar and has also recrystallized into polygonal aggregates. Photomicrograph, crossed nicols.

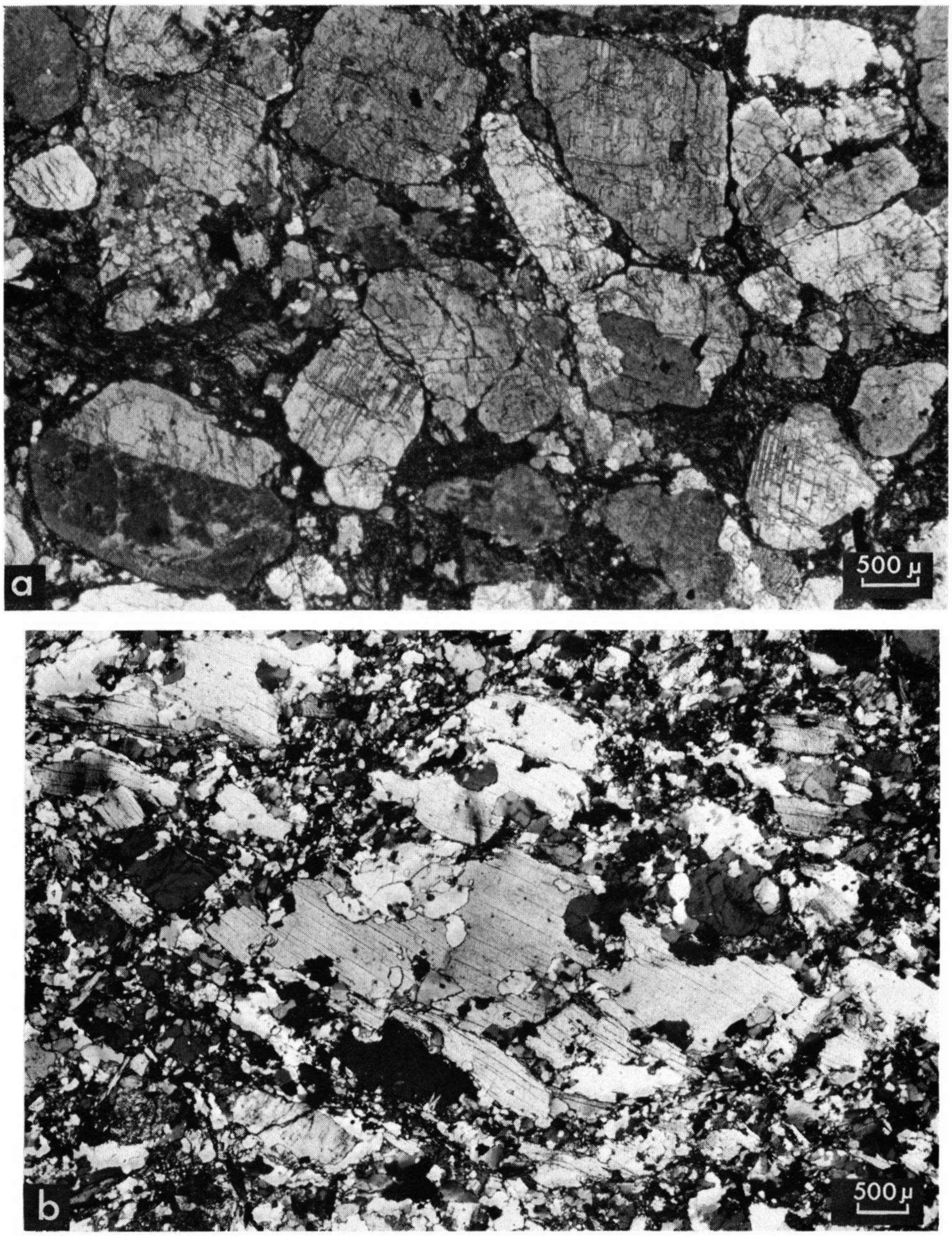

a
500 μ
b
500 μ
c
500 μ

PLATE X

a. Paragneiss xenolith in the megacrystal-bearing granodiorite. Relatively large plagioclase crystals are the result of metasomatism (St. 141791).
b. A cognate hornblende-biotite diorite inclusion in the megacrystal-bearing granodiorite. Note the large (only slightly deformed) biotite flakes in contrast to the more finely grained hornblende and plagioclase (St. 141792).
c. Highly phyllonitic and partly mylonitic megacrystal-bearing granodiorite (F_3). Quarry at Pta. Requeixo.
d. Muscovite granite (phyllonitic), a relatively late-magmatic product of the megacrystal-bearing granodiorite series (St. 141809).

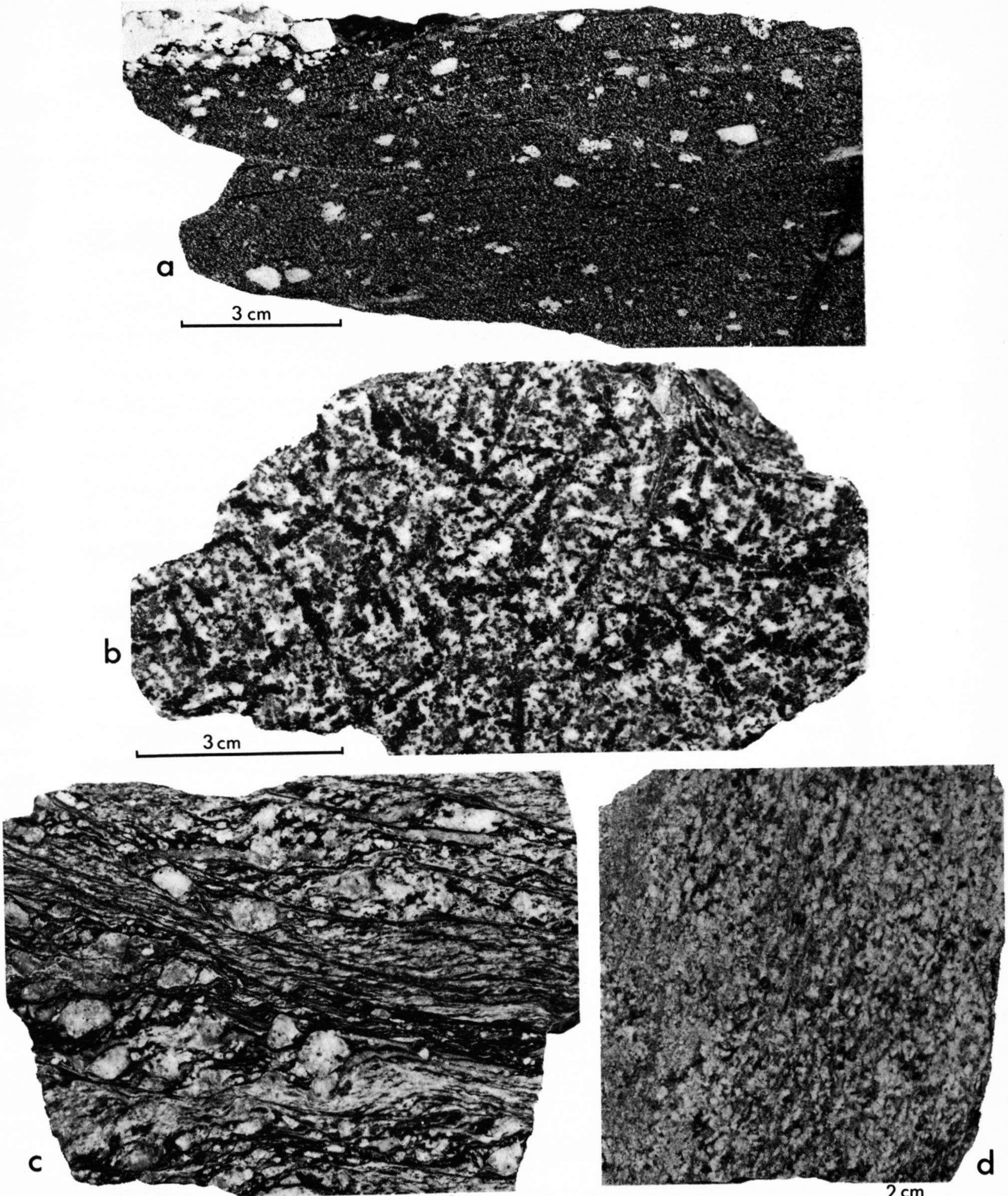

a
3 cm
b
3 cm
c
2 cm
d
2 cm

PLATE XI

a. Two varieties of the medium to coarse-grained two-mica granite (Barbanza-type): the older muscovite-rich type (below) and the biotite-rich type (above); samples St. 141822 and St. 141823, respectively.
b. The medium to coarse-grained Barbanza two-mica granite (St. 141827), often inhomogeneous and locally phyllonitic.
c. The medium-grained two-mica granite (Banza-type) containing a fine-grained two-mica granite inclusion (St. 141831). Both granites are cut off by a pegmatite.

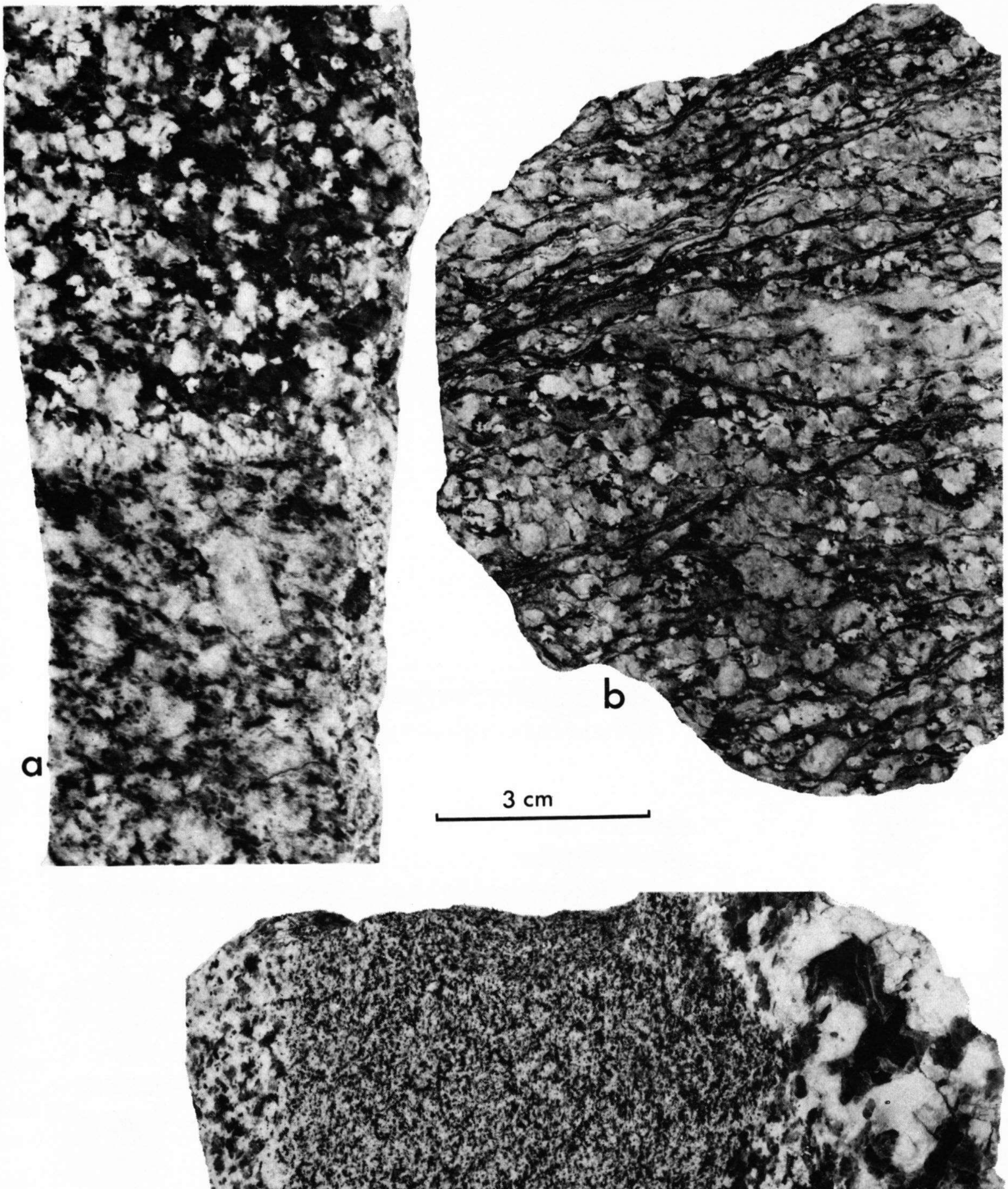

a
b
3 cm
c

PLATE XII

a. The late syn-kinematic megacrystal-bearing Ruña two-mica granite (St. 141839).
b. The post-kinematic Arbos granite, a coarse-grained megacrystal-bearing two-mica granite (St. 141855).
c. The post-kinematic Pando granite, a medium to coarse-grained slightly porphyritic biotite granite (St. 141817).
d. The post-kinematic Caldas de Reyes granite, a coarse-grained slightly porphyritic amphibole-bearing biotite granite (St. 141814).

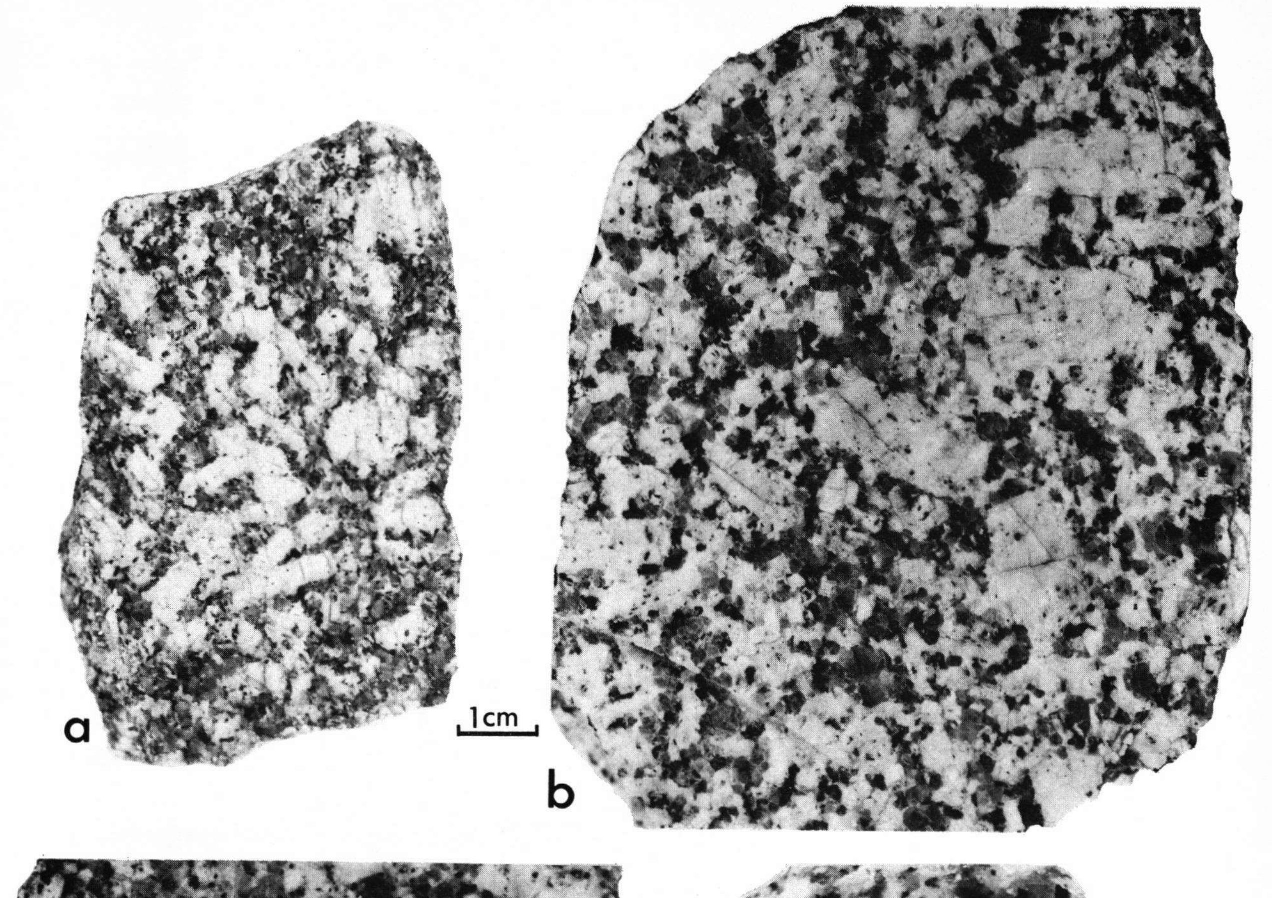

a
1cm
b
c
1cm
d

PLATE XIII

Zircons from biotite orthogneiss:
a. Zircon showing an interrupted growth (St. 141717, × 160).
b. Oblong crystal from same sample with the forms {101} and {110}. Magn. 160 ×.

Zircons from biotite-ferrohastingsite orthogneiss:
c. Crystal with damaged faces. Note the presence of {301} in addition to {101} and {100}. Magn. 242 × (Stereoscan, photo 11372, Centr. Lab. TNO, Delft).
d. Composite zircon from same sample. Magn. 121 × (Stereoscan, photo 11374, Centr. Lab. TNO, Delft).
e. Heavily resorbed crystal showing an interrupted growth (St. 141860, × 400).
f. Resorbed crystal with inclusions concentrated in the rim. (St. 141860, × 160).
g. Zircon aggregate consisting of three intergrown crystals and a core. Magn. 160 ×.
h. Zoned zircon with core crowded with inclusions. A small zircon inclusion is oriented // {101}. The contours clearly reveal the presence of {301}, this form is not visible in the core. Magn. 320 ×.

i. Zircon from amphibole-bearing biotite orthogneiss. (St. 141727, × 320).

Zircons from migmatic biotite orthogneiss:
j. A crystal showing the forms {101}, {100} and (subordinate) {110}. The numerous inclusions are seemingly not oriented. The upper part of the crystal is overgrown due to migmatic recrystallization (St. 141789, × 240).
k. Most of the crystals are heavily resorbed and have smooth surfaces (St. 141789, × 200).

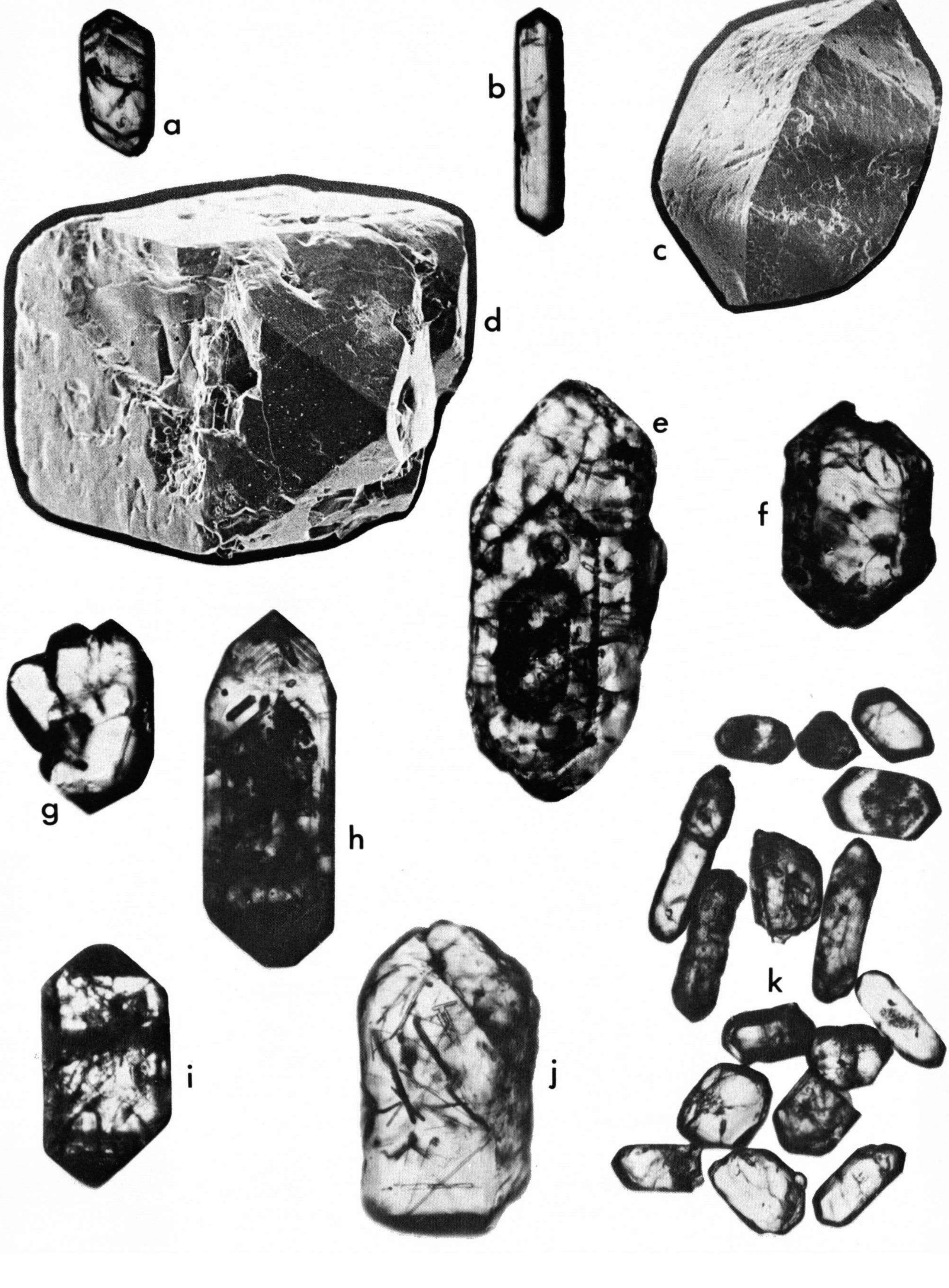

a
b
c
d
e
f
g
h
i
j
k

PLATE XIV

Zircons from coarse-grained augengneisses:

a. A crystal displaying the forms {101}, somewhat subordinate {211} and {110}. The crystal edges are only slightly resorbed. Magn. 110 × (Stereoscan, photo 11379, Centr. Lab. TNO, Delft). Sample St. 141781.

b. A zircon with the important form {211} as well as {101}, {110} and subordinate {100}; also a heavily resorbed monazite crystal. Magn. 220 × (Stereoscan, photo 11376, Centr. Lab. TNO, Delft). Same Sample.

c. Egg-shaped clear crystal with {211} as an important face (St. 141783, × 160).

d. Oblong and partially zoned crystal (St. 141781, × 160).

e. Highly elongated and highly resorbed crystal. (St. 141778, × 160).

f. Zircon with aberrant shape enclosing a normal core (St. 141778, × 160).

g. Zircon with a rounded, probably sedimentary, zircon core (St. 141778, × 160).

h. Zircon aggregate with resorbed core and euhedral overgrowth (St. 141783, × 160).

i. Resorbed crystal with an aberrant morphology (St. 141782, × 160).

j. Clear and euhedral crystal (St. 141781, × 160).

k. Euhedral crystals; the large crystal displays the forms {211}, {100} and {110}, while {101} is absent. Magn. 110 × (Stereoscan, photo 11380, Centr. Lab. TNO, Delft). Sample St. 141781.

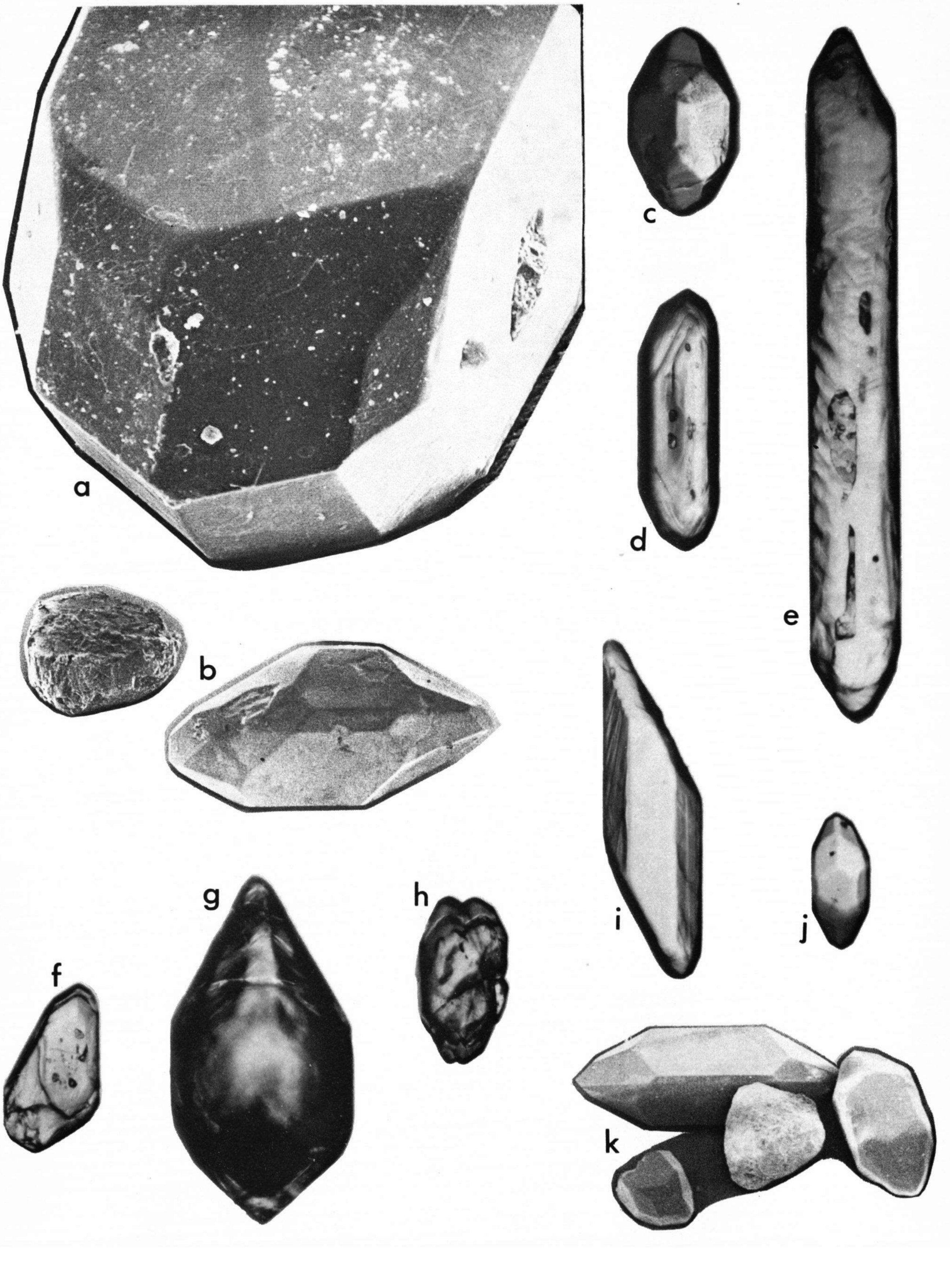

a
b
c
d
e
f
g
h
i
j
k

PLATE XV

Zircons from granodioritic cognate inclusions belonging to the megacrystal-bearing granodiorite series:

a. A zircon with an aberrant pseudo-rhombic shape, displaying the crystal forms $\{101\}$, $\{100\}$, subordinate $\{301\}$, subordinate $\{211\}$ and $\{110\}$. Magn. 770 × (Stereoscan, photo 11388, Centr. Lab. TNO, Delft).

b. A broken crystal with the forms $\{101\}$, $\{100\}$ and $\{110\}$. Magn. 990 × (Stereoscan, photo 11383, Centr. Lab. TNO, Delft).

c. Euhedral crystal with different inclusions. Magn. 160 ×.

d. Isometric zircon crystal with the shape of a dodecahedron. Magn. 320 ×.

e. Oblong crystal with aberrant shape: breadth > thickness. Magn. 160 ×.

f. An early-broken-later-healed zircon crystal that survived mechanical crushing. Magn. 569 ×.

(Photos a-f are from sample St. 141795; photos g-i from sample St. 141793).

g. A highly resorbed zircon aggregate. Magn. 160 ×.

h. Highly resorbed crystal with gaseous and two-phase inclusions. Magn. 300 ×.

i. Highly resorbed crystals with two-phase inclusions, showing evidence of a hindered growth. Magn. 160 ×.

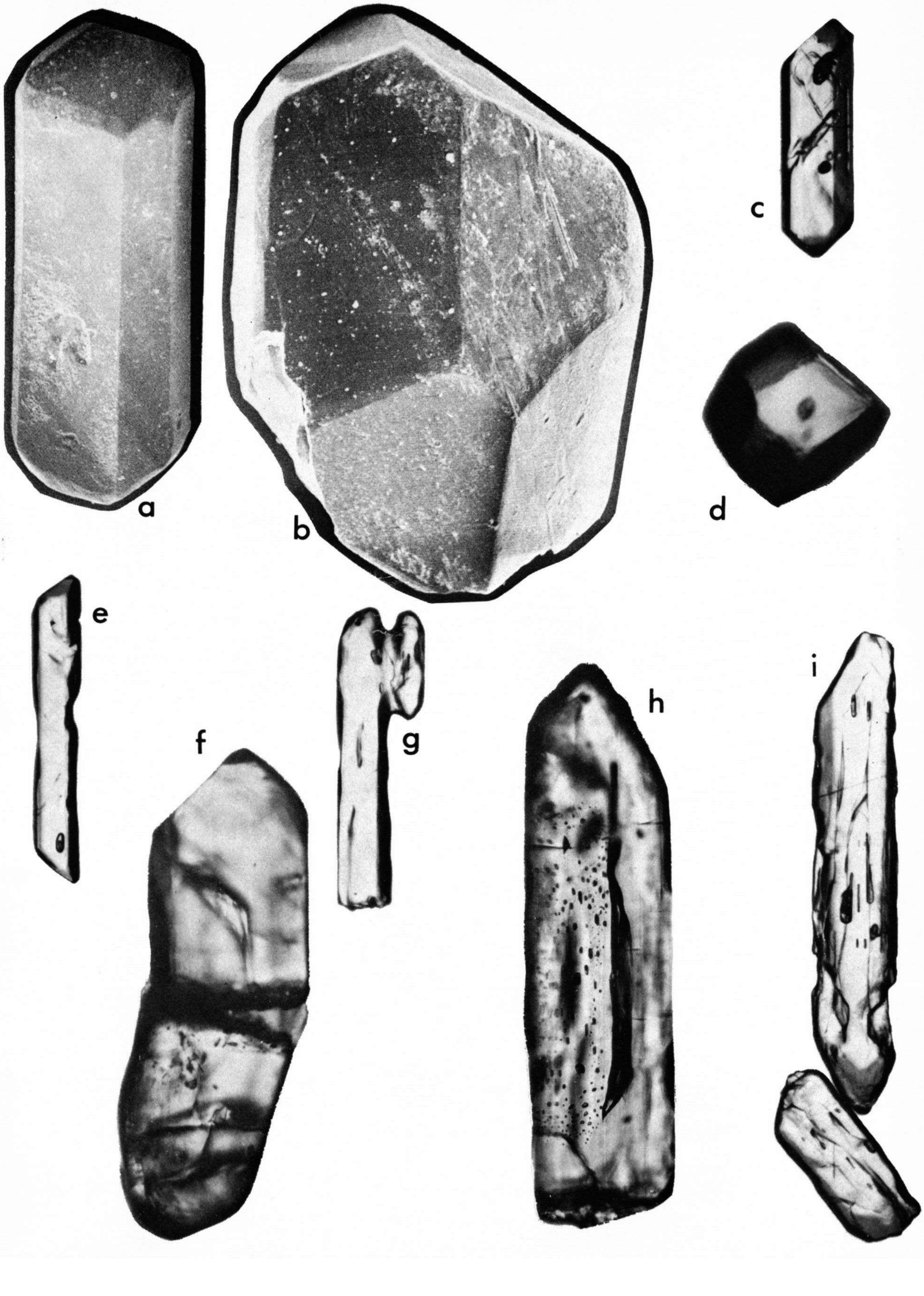

a
b
c
d
e
f
g
h
i

PLATE XVI

Zircons from megacrystal-bearing granodiorite and muscovite granite:
a. Aberrant shape $\{211\}$ as an important crystal form (St. 141804, $\times$ 160).
b. Oblong crystal with resorbed core (St. 141861, $\times$ 160).
c. Zoned crystal with inclusions attached to growth zones (St. 141804, $\times$ 200).
d. and e. Aberrant shapes often present in the megacrystal-bearing granodiorite (St. 141861, $\times$ 240).
f. Resorbed zircon aggregate (St. 141804, $\times$ 200).
g. Clear evidence of a hindered growth. Crystal form $\{101\}$ is subordinate or absent (St. 141861, $\times$ 160).
h. Resorbed zircon with turbid core and finely zoned rim from muscovite granite (St. 141809, $\times$ 240).

i. Heavily resorbed euhedral monazite crystal (St. 141805, $\times$ 400).
j. Heavily resorbed xenotime partly enclosing a zircon (St. 141805, $\times$ 400).
k. Euhedral brookite crystal (St. 141776, $\times$ 160).
l. Euhedral anatase crystal (St. 141776, $\times$ 160).
m. Fibrolitic anatase (St. 141776, $\times$ 160).

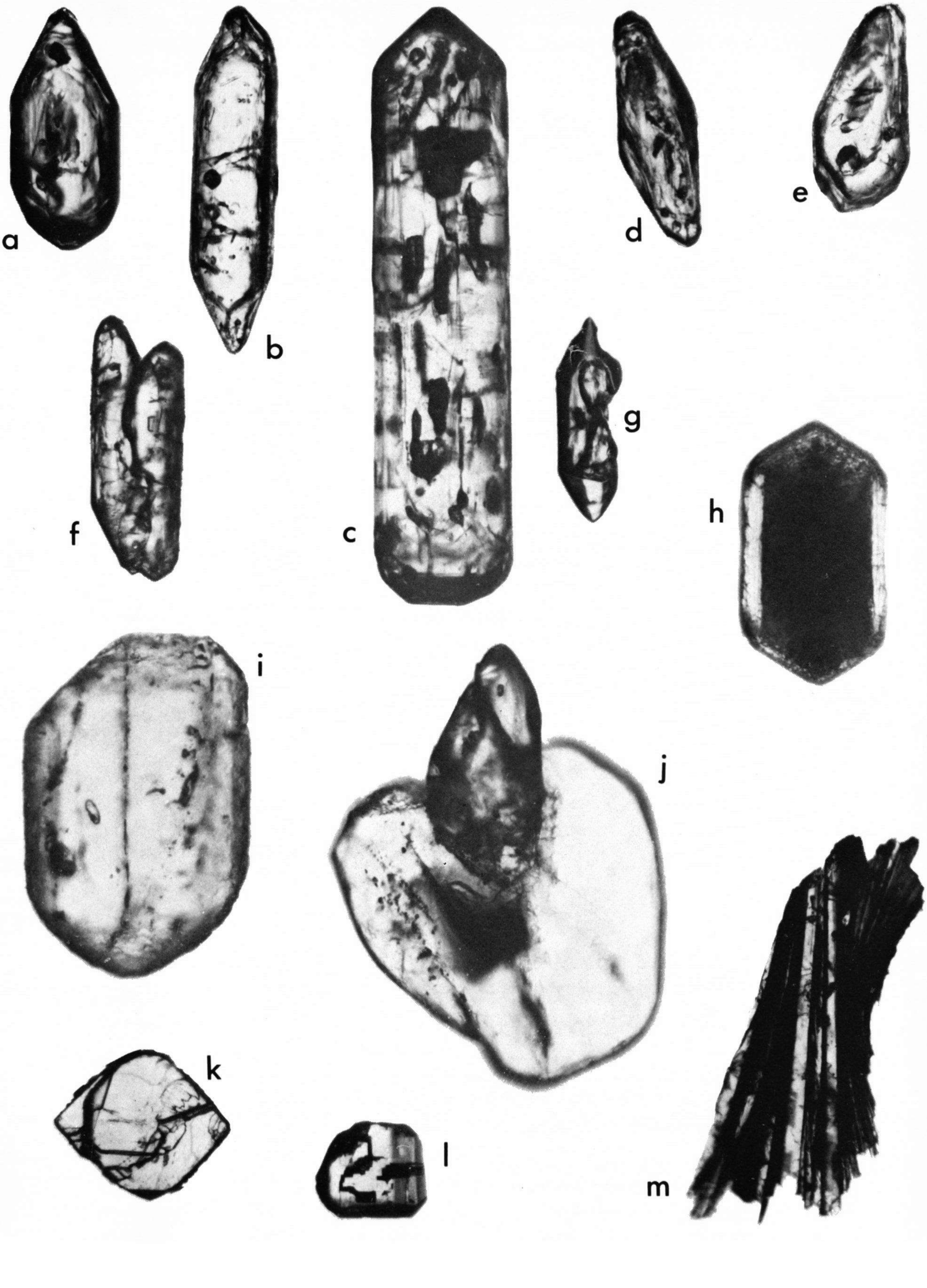
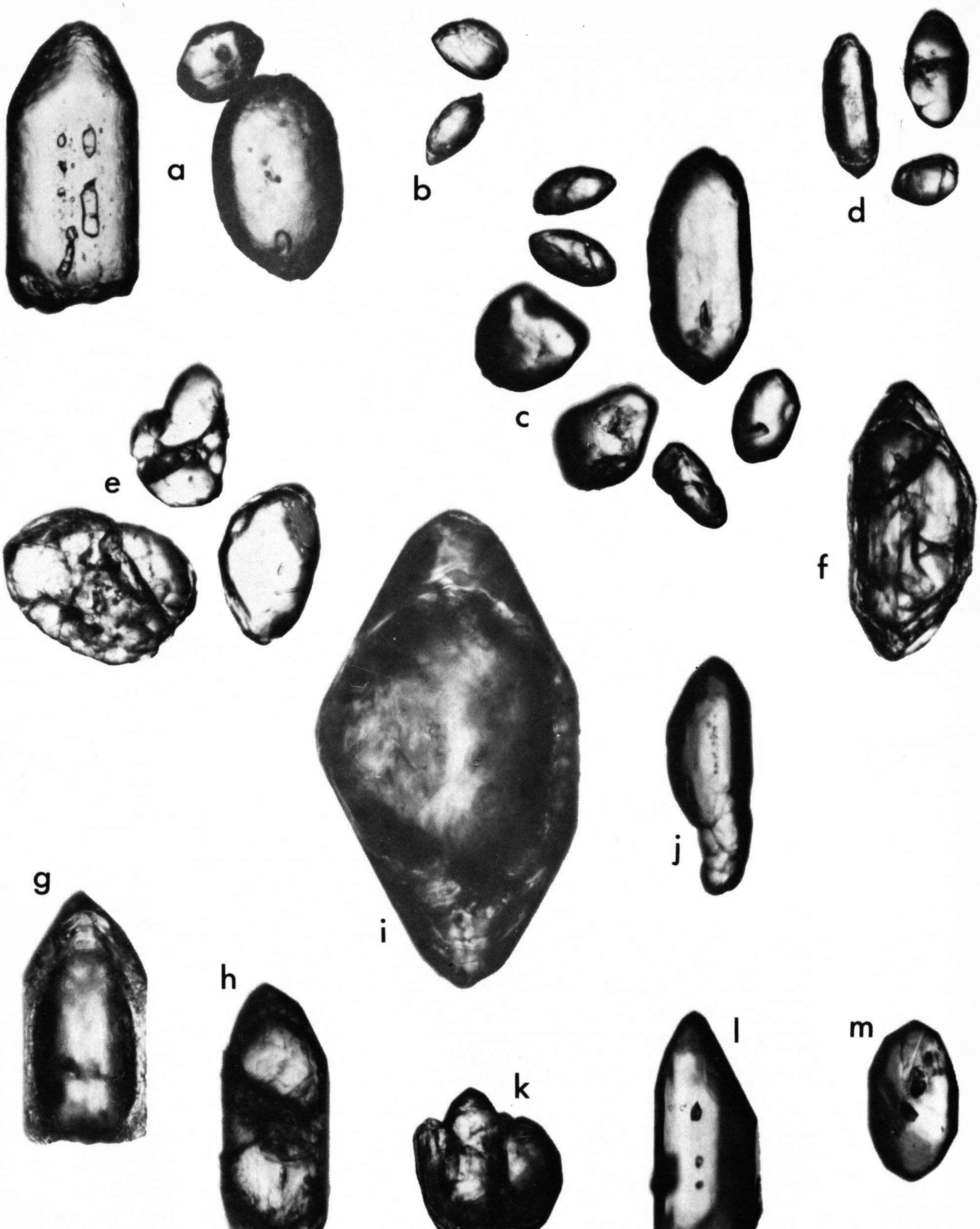

a
b
c
d
e
f
g
h
i
j
k
l
m

PLATE XVII

a. "Sedimentary" zircons from metaquartzite (St. 141699, $\times$ 220).

Zircons from migmatites:
b. Resorbed "sedimentary" zircons with outgrowths; pegmatoid metatect of a migmatite. Magn. 160 $\times$.
c. Resorbed zircon grains in restite (St. 141776, $\times$ 160).
d, e and f. Resorbed zircons with newly formed outgrowths from paragneiss migmatite (St. 141773, $\times$ 160).
g, h and i. Regenerated zircons from metatect of an inhomogeneous diatexite (St. 141776).
Zircon from photo h encloses two sedimentary cores. Magn. 160 $\times$, 240 $\times$ and 500 $\times$, respectively.
Note the differences with respect to the zircons from the restite of the same sample (photo c).

Zircons from granitoid migmatite (see Chapter I, Fig. 1-27):
j. Euhedral crystal with irregular outgrowth. Magn. 300 $\times$.
k. Zircon aggregate with resorbed cores and overgrowths. Magn. 160 $\times$.
l. and m. Newly grown euhedral crystals with the forms $\{101\}$, $\{211\}$, $\{100\}$ and $\{110\}$. Magn. 160 $\times$.


a
b
c
d
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f
g
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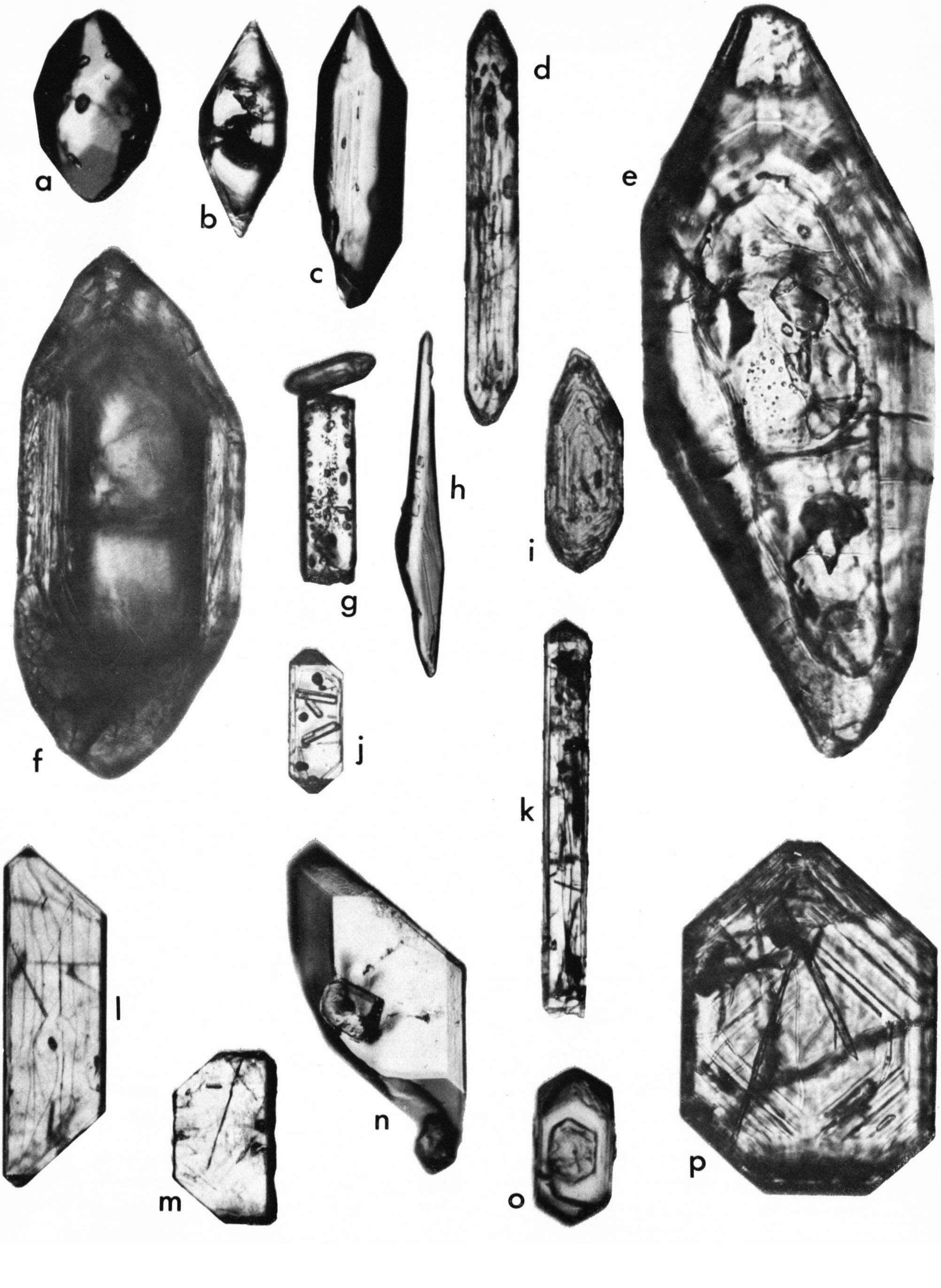
i
j
k
l
m

PLATE XVIII

Zircons from two-mica granites:
a. An oval-shaped crystal from the Banza granite. Magn. 160 ×.
b. Zircon from the Barbanza granite; form {101} is (almost?) absent (St. 141824, × 160).
c. and d. Oblong crystals from eastern two-mica granites. Zircon d is zoned with inclusions attached to the growth-zones. Magn. 160 × and 240 ×, respectively (St. 141838 and St. 141837).
e. Zoned zircon with resorbed core from Barbanza granite. Magn. 400 × (St. 141824).
f. Regenerated zircon with "sedimentary" zircon core and zoned rim with low birefringence (St. 141821, × 400).
g. Zircon fragment with numerous small and rounded inclusions; eastern two-mica granite. Magn. 160 ×.
h. Aberrant crystal shape; eastern two-mica granite (St. 141838, × 160).
i. Markedly zoned zircon from Ruña granite, a typical feature (St. 141839, × 140).

Zircons from granite porphyry (St. 141858):
j. Crystal with the forms {101} and {100}, enclosing smaller zircons and opaque minerals. Magn. 160 ×.
k, l and m. Aberrant crystal shapes; k: length $\gg$ breadth $\approx$ thickness, l and m: length $>$ breadth $\gg$ thickness. Magn. 160 ×.
n. Aberrant shape with sharp outlines displaying the forms {101}, {110} and {100}. Magn. 160 ×.
o. Crystal with the forms {101} and {110}, enclosing a resorbed core. Magn. 300 ×.
p. Markedly zoned crystal; the prismatic forms in the inner part of the crystal have developed very subordinately. Magn. 400 ×.


a
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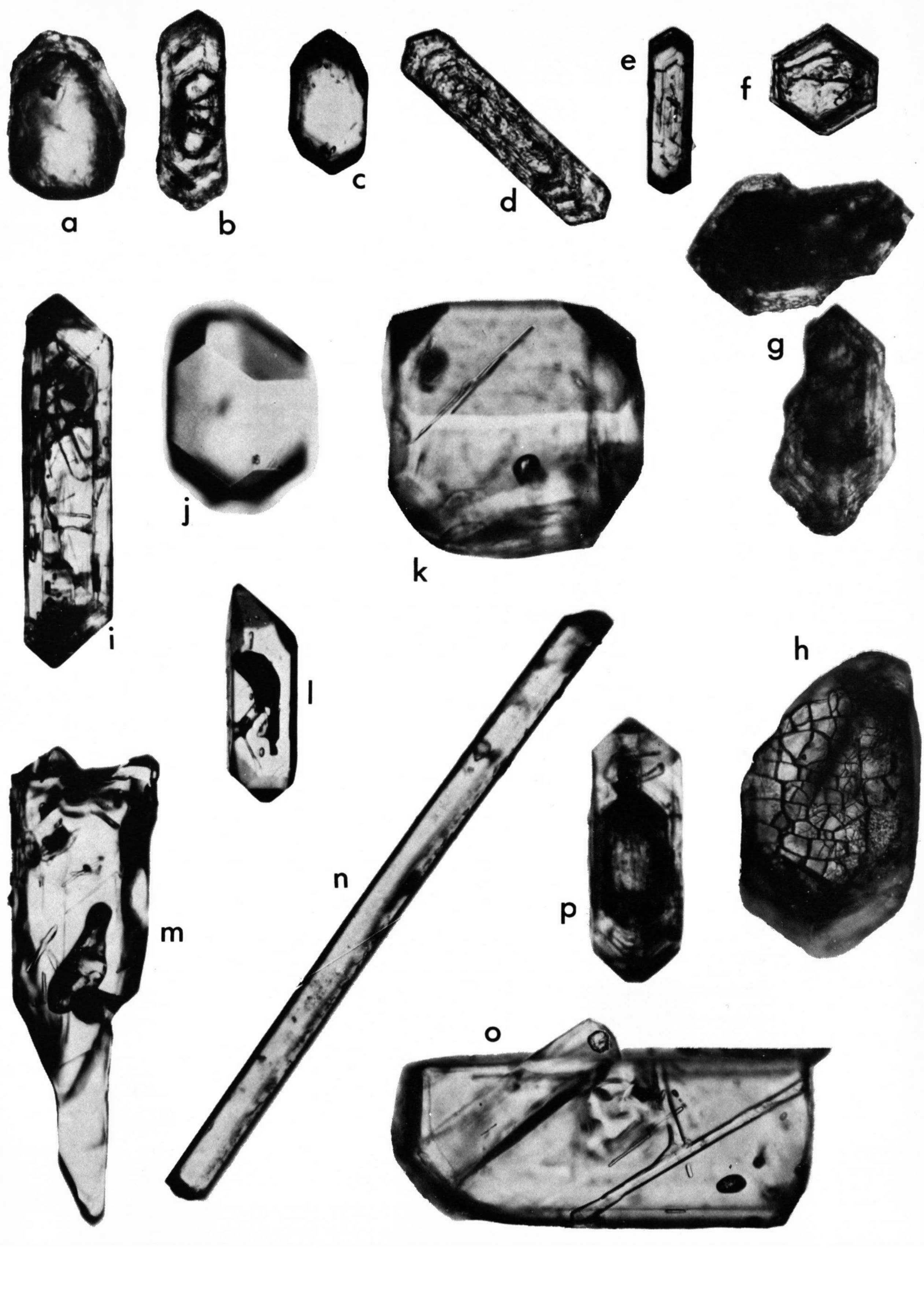
m
n
o
p

PLATE XIX

Zircons from the post-kinematic Arbos granite:
a. Sedimentary zircon with outgrowth (St. 141854, × 160).
b. Regenerated zircon with "sedimentary" core and finely zoned rim enclosing a small euhedral zircon (St. 141855, × 160).
c. Newly grown euhedral crystal (St. 141855, × 160).
d. Oblong zircon showing a marked zoning and interrupted growth. Magn. 400 × (St. 141855). A characteristical zircon habit for the Arbos granite.

Zircons from the post-kinematic Pando granite (St. 141816):
e. Zoned zircon with the forms $\{101\}$ and $\{110\}$. Magn. 160 ×.
f. Equidimensional zircon displaying an interrupted growth. Magn. 160 ×.
g. Typical zircons from the Pando granite with turbid euhedral and sometimes resorbed cores and finely zoned rims with low birefringence. The fluorescence colour of these cores is usually green. Magn. 220 ×.
h. Microcracks on a crystal surface. The fractures are the result of expansion caused by metamictization. Magn. 340 ×.

Zircons from the post-kinematic Caldas de Reyes granite (mainly St. 141863):
i. Crystal with core of same shape and many inclusions. Magn. 160 ×.
j. Euhedral zircon with the forms $\{101\}$, $\{110\}$ and $\{100\}$. Magn. 160 ×.
k. Aberrant crystal with the forms $\{101\}$, $\{100\}$ and subordinate $\{110\}$. Magn. 400 ×.
l. Crystal with gaseous and liquid inclusions. Magn. 160 ×.
m. Irregular crystal shape due to a hindered growth enclosing gaseous and liquid inclusions. Magn. 160 ×.
n. Aberrant shape: length $\gg$ breadth $\approx$ thickness. Magn. 200 × (St. 141813).
o. Irregular grain with large apatite inclusion and liquid canals. Magn. 300 ×.
p. Zoned zircon with turbid core. Magn. 300 ×.


a
b
c
d
e
f
g
h
i
j
k
l
m
n
o
p

GEOLOGICAL MAP OF THE AREA AROUND NOYA (NW SPAIN)
BETWEEN THE RIO JALLAS AND THE RIA DE AROSA
BY C.E.S. ARPS
SCALE 1: 50 000
PRE-HERCYNIAN ROCKS
paragneiss
A: andalusite-bearing P: plagioclaseblast-bearing
H: paragneiss with a hornfelsic appearance
schist with graphite schist intercalation
metaquartzites
biotite orthogneiss
(linear, planolinear, augen-bearing)
hornblende-biotite orthogneiss (Noya)
biotite-ferrohastingsite orthogneiss (N); leucocratic and melanocratic varieties
(aegirine)-riebeckite orthogneiss (per-alkaline)
amphibolites
coarse-grained augengneiss
HERCYNIAN ROCKS
migmatic paragneiss and schist
migmatic biotite orthogneiss
migmatic coarse-grained augengneiss
gneissic migmatites
augengneiss migmatite
megacrystal-bearing granodiorite with (grano) diorite cognate inclusion
muscovite granite (phyllonitic)
medium to coarse-grained two-mica granite (oriented, unoriented, phyllonitic, megacrystal-bearing)
medium to fine-grained two-mica granite (oriented, phyllonitic, megacrystal-bearing)
megacrystal-bearing two-mica granite
M: muscovite granite variety
biotite granite
H: amphibole-bearing
pegmatite
aplite
granite porphyry
lamprophyre
dolerite
brecciated rock
mylonite
quartz vein
calc-silicate lense
Quaternary terrace deposit
recent deposit
colluvium
fault
inferred fault
master joints
strike and dip of schistosity
strike and plunge of lineation
GEOLOGICAL BOUNDARY
inferred
accurate
TOPOGRAPHY
paved road
village or hamlet
river or brook
marsh
contour lines, interval 50 m
triangulation point
GEOLOGY BY GRADUATE STUDENTS 1959-1962
A : C.E.S. Arps
Al: H.G. Avé Lallemant
B : J.B.M. ten Bosch
G : W.P.F.H. de Graaff
K : A.F. Koster van Groos
M : E.H. von Metzsch
R : I.B.H.M. Rubbens
COMPLETED BY C.E.S.ARPS 1964-1966
Ocean
Atlantic
Coruña
Santiago de Compostela
PORTUGAL
B
C
D
E
A
5° 22' (west of madrid)
5° 18'
5° 14'
5° 10'
5° 06'
Pte. Olveira
Jallas
Rio Mazaricos
Mtes. de Rufio
Picota
Pino de Val
Suevos
Banza
Bella
Sierra de Outes
Tremuzo
Ens. del Engaño
Pte. de Don Alonso
Tambre
Esteiro
Ens. del Esteiro
Freijo
Pta. Peón
Barquiña
Pta. del Requeixo
MUROS
Pta. Testal
Barro
NOYA
Y
DE
RIA
Pta. Boa
San Lois
Portosin
San Justo
Mtes. de Pedrantos
San Finx
El Confurco
Moimenta
Beluso
Pedride
Sandrezo
Pte. Beluso
Pta. Leixón
Ens. de Carballeira
Lampón
Goyanes
Boiro
Barraña
Riajo
da Pena
Abanqueiro
Pesqueira
Cabo Cruz
Pta. de Pedro Rubion
Ens. de Las Canchas
Ens. del Rial
AROSA
Chazo
42° 57' 30"
42° 55'
42° 52' 30"
42° 50'
42° 47' 30"
42° 45'
42° 42' 30"
42° 40'
42° 37' 30"
1ª edición autorizada por el Consejo Superior Geográfico en 21-12-70
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				S,SW and W unit	western migmatic complex	central zone	eastern migmatic complex					
					terrace deposits: Goyanes; Barquiña-Barro;	Abanqueiro		Quaternary				
block faulting regional uplift					olivine dolerite		(olivine dolerite)	Tertiary Cretaceous Permian	rejuvenation of relief erosion to peneplain			
block faulting regional updoming	tension			granite porphyries	lamprophyres, granite porphyries [apophyses] Pando granite: biotite granite Caldas de Reyes granite: amphibole-bearing biotite granite ↕ ? Arbos granite: megacrystal-bearing two-mica granite	lamprophyres, granite porphyries [apophyses] aplites, quartz veins	lamprophyres, granite porphyries	Carboniferous 280 ± 11 x 10^6 years ago (whole rock)	contact metamorphism	emplacement of post-kinematic granites Sn-W mineralizations: San Finx, Lampón, etc.	epizonal	HERCYNIAN
wrench-faults mylonitization phyllonitization	(E)NE-(W)SW compression	locally destructive	F3	pegmatites, aplites, quartz veins	pegmatites, aplites, quartz veins	pegmatites, aplites, quartz veins	pegmatites, aplites, quartz veins	F3	retrogradation			
subsidence S,SW and W unit	tension			[apophyses] Ruña granite: megacrystal-bearing two-mica granite						intrusion of late syn-kinematic allochthonous two-mica granite	↑ epi-mesozonal	
	(t)NE-(W)SW compression	weak; non-penetrative	F2		pegmatites, aplites, quartz veins pegmatites, aplites, quartz veins	pegmatites, aplites, quartz veins pegmatites, aplites, quartz veins	pegmatites, aplites, quartz veins pegmatites, aplites, quartz veins	F2	crystallization of micas and andalusite in newly-formed cleavage planes			
	↑			Muros granites {fine-grained two-mica granite very fine-grained two-mica granite medium-grained two-mica granite ?	southern two-mica granites	Banza granite {medium-grained two-mica granite ↑ fine-grained two-mica granite	eastern medium to fine-grained two-mica granites (several generations)	298 ± 10 x 10^6 years ago (whole rock)	schist xenoliths in Barbanza granite: hornblende-hornfels to alk. feldspar-cordierite hornfels facies of thermo-metamorphism	emplacement of syn-kinematic parautochthonous to allochthonous two-mica granites		
				Barbanza granites {medium to coarse-grained two-mica granite medium to coarse-grained biotite-bearing muscovite granite								
synthetic faults subsidence of central zone along fundamental fault	tension ↓				pegmatites ↑ fine-grained two-mica granites ↑ aplogranites and pegmaplites magmatic series: ↑ [pegmatites] aplites muscovite granite coarse-grained two-mica granite megacrystal-bearing granodiorite dioritic and granodioritic cognate inclusions		pegmatites megacrystal-bearing grano-diorites (grano)diorites		albitization of oligoclase metablasts in paragneiss around amphibole-bearing orthogneiss (central zone) oligoclase metablastesis in paragneiss; metablastic recrystallization of mylonitic orthogneiss	emplacement of early syn-kinematic megacrystal-bearing granodiorite series along fundamental faults		
				greenschist facies: quartz-andalusite-plagioclase-chlorite facies (epi-mesozonal)	migmatization of metasediments, coarse-grained augengneiss and biotite orthogneiss	cordierite-amphibolite facies: sillimanite-cordierite-muscovite-almandine subfacies	migmatization of metasediments, coarse-grained augengneiss, biotite orthogneiss		Abukuma-type plutonometamorphism		mesozonal	
(F1 is main deformation) mylonitization phyllonitization	(E)NE-(W)SW compression	strong; penetrative	F1		coarse-grained augengneiss ↑ phyllonitization	linear to planolinear granite mylonites ↑ mylonitization		F1				
			? F0			gneissic granites ?		F0 ?				
	tension			[basic in/extrusions] sedimentation of pelitic and quartzitic rocks ?	coarse-grained megacrystal-bearing two-mica granite	biotite-ferrohastingsite granite, per-alkaline granite basic dyke swarms [apophyses] (hornblende-) biotite granites	coarse-grained megacrystal-bearing two-mica granite	Upper Ordovician: 430-460 x 10^6 years ago (whole rock) Early Paleozoic		emplacement of granites along fundamental faults	mesozonal → epizonal	PRE-HERCYNIAN
	compression	penetrative	F		metamorphism (garnet; staurolite; hornblende; micas) geosynclinal sedimentation of greywackes, pelitic and quartzitic rocks with calcareous intercalations			Precambrian F	Barrow-type metamorphism ?		mesozonal	
				S,SW and W unit	western migmatic complex	central zone	eastern migmatic complex					

Synoptic chronological table for geological events in the area around Noya (NW Spain)

[apophyses]: present, but (very) subordinate

Table I – 1 Non-migmatic paragneisses and schists

(1) in the S and SW; (2) in the central zone

Columns — constituent minerals: opaque/ore mineral; zircon; monazite/xenotime; apatite; titanite; rutile; anatase/brookite; tourmaline; garnet; graphite; andalusite; sillimanite; staurolite; biotite; chlorite; muscovite; sericite; quartz; alkali feldspar/adularia; plagioclase. quartz: drops and small grains in plagioclase; larger grains; in veins or lenses; larger grains: dimensional preferred orientation; strained; larger grains: recrystallized; mosaic/polygonal. plagioclase: anorthite % (10, 20, 30, 40); twinning: (010) twins; (001) twins; simple twins; lamellar twins; zoning: normal; inverse; oscillating; albitization; metablastic: albite; oligoclase. biotite: reddish brown; (dark) brown; early generation; larger grains // foliation; late generation ⊥ foliation. muscovite: early generation; larger grains // foliation; late generation ⊥ foliation. andalusite: pre/syn-kinematic; post-kinematic. sillimanite: sill. with muscovite and quartz; sill. with biotite; sill. with andalusite. fabric: banded or layered; veins (v); lenses (l); inequigranular; granoblastic; hornfelsic; poikiloblasts with Si.

Sample numbers: (1) 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716; (2) 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 109750, 695, 696, 697, 698, 699, 700, 701, 702

Table I – 2 Biotite orthogneisses and amphibole-bearing orthogneisses

Columns — constituent minerals: opaque/ore mineral; zircon; apatite; fluorite; titanite; pyrochlore; xenotime; tourmaline; garnet; astrophyllite; aegirine; riebeckite; arfvedsonitic hornblende; ferrohastingsite; blue-green hornblende; epidote/clinozoisite; allanite; biotite; chlorite; muscovite/sericite; quartz; alkali feldspar; plagioclase. quartz: inclusions in feldspar; dimensional preferred orientation; strained; recrystallized: polygonal/mosaic outlines. plagioclase: anorthite % (10, 20, 30); twinning: (010) twins; (001) twins; simple; multiple; zoning: untwinned (and zoned); normal; inverse; young relative large albite individuals; albitization/decalcification rims; inclusion in alkali feldspar; myrmekite. alkali feldspar: megacrystals or augen; carlsbad twins; cross-hatching; perthite. hornblende or ferrohastingsite: darkly coloured; 2Vα. biotite: reddish brown; (dark) brown. fabric: aplitic or aplogranitic; linear; plano-linear; mylonitic or strongly cataclastic; mortarzones; blastomylonitic.

Sample numbers: 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 109737, 109739, 109740

Table I – 3 Amphibolites and calc-silicates

(1) amphibolites in central zone; (2) amphibolites in SW and S

Columns — constituent minerals: opaque/ore minerals; zircon; apatite; titanite; rutile; garnet; graphite; pyroxene; blue-green hornblende; cummingtonite; allanite; epidote/clinozoisite; biotite; chlorite; muscovite/sericite; quartz; plagioclase; saussurite. quartz: drops in plagioclase; larger grains. plagioclase: anorthite % (10–80); twinning: (010) twins; (001) twins; simple twins; multiple twins; zoning: normal; inverse; oscillating; zoned and untwinned; very fine-grained "groundmass"; larger grains; metablastic. hornblende: colour: normal (n), weak (l), dark (d); small generation in plagioclase; small generation "groundmass", mainly not oriented; larger grains (001) // Se markedly; larger grains (001) // Se moderately or weakly; metablastic; late generation (L); 2Vα 80; 2Vα 50. cummingtonite: 2Vγ; replacing hornblende; new generation, often oblique to foliation; twinned. garnet: euhedral, altered; relics, atolls etc.; max. diam. in mm. fabric: poikiloblasts with Si; meta-porphyritic; hornfelsic (h), massive (m); banded or layered (b), schistose (s); para-amphibolite (p); ortho-amphibolite (o).

Sample numbers: (1) 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749; (2) 750, 751, 752, 753 (relics), 754, 755, 756, 757, 758, 759, 760, 260, 761, 762, 763

Qualitative mineralogical composition and other properties for the rocks of the area around Noya

- \+ main constituent
- – accessory constituent
- ( ) altered
- o relatively important property
- · subordinate property

Of all sample numbers consisting of three figures the prefix St. 141 is omitted

Table I – 4 Migmatic metasediments, migmatic coarse-grained augengneiss and migmatic biotite orthogneiss

Columns — constituent minerals: opaque/ore minerals; zircon; monazite/xenotime; apatite; fluorite; titanite; rutile; anatase/brookite; tourmaline; garnet; sillimanite; beryl; biotite; chlorite; muscovite; sericite; quartz; alkali feldspar; plagioclase; saussurite. quartz: drops and small equidimensional inclusions; h.t. quartz; main generation: dimensionally preferred orientation; strained; main generation: primary crystalline; recrystallized (mosaic/polygonal); convex outlines (corrosive quartz). plagioclase: anorthite % (10, 20, 30); twinning: (010) twins; (001) twins; multiple twins; zoning: normal; inverse; oscillating; untwinned (and zoned); small early generation; megacrystals; albitization; decalcification; myrmekite. alkali feldspar: megacrystals; carlsbad twins; cross-hatching; perthite. biotite: reddish brown; (dark) brown; older generation (pre-migmatic) // Se; new generation, relatively large individuals, sometimes ⊥ Se or // Se; lepidoblasts. muscovite: relatively older generation // Se, often ⊥ Se; new generation; relatively large individuals, often ⊥ Se; lepidoblasts. sillimanite: needles in muscovite and/or quartz; fibrolitic masses, generally // Se; grains; strongly altered into sericite; at the expence of biotite (b) or muscovite (m). fabric: mortar texture; deformed (Fs/Fs); strongly deformed (mainly Fs); granoblastic (neosome or complete); inequigranular. migmatic gneiss/schist (pegmatoid/granitoid) <25% neosome; gneissic migmatite (pegmatoid/granitoid) 25–75% neosome; granitoid migmatite >75% neosome.

Sample numbers: 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790

Table I – 5 Megacrystal-bearing granodiorite magmatic series, post-kinematic biotite granites, lamprophyres and a olivine dolerite

(1) paragneiss xenolith; (2) cognate inclusions; (3) megacr.-bearing granodiorite; (4) muscovite granite and aplites; (5) Caldas de Reyes granite; (6) Pando granite; (7) lamprophyres and (8) olivine dolerite

Columns — constituent minerals: opaque/ore minerals; zircon; monazite/xenotime; apatite; fluorite; analcime (a); titanite; rutile; anatase/brookite; tourmaline; beryl; garnet; olivine; pyroxene; bl. gr. hornblende; brown hornblende in lamprophyres; dark green amphibole; clinozoisite/epidote; allanite; sillimanite; biotite; chlorite; muscovite; sericite; quartz; alkali feldspar; plagioclase; saussurite; calcite. quartz: drops and small equidimensional inclusions; h.t. quartz; main generation: dimensional preferred orientation; strained; main generation: primary cristalline (xenom); recryst. polygonal/mosaic. plagioclase: anorthite % (10–60); twinning: (010) twins; (001) twins; multiple twins; carlsbad-albite twins; zoning: normal; inverse; oscillating, sometimes irregular; small, early generation in alkali feldspar; relatively large (hypidiomorphic) crystals; albitization; relative large albites; decalcification; myrmekite. alkali feldspar: megacrystals; carlsbad twins; cross-hatching; perthite. biotite: reddish brown; (dark) brown; small and relatively early. zircon: sedimentary zircon; idiomorphic. apatite: relatively large euhedral to subhedral grains; (long) small needles in quartz and feldspar. fabric: unstrained rock; deformed (mainly Fs); strongly deformed (Fs) phyllonite; cataclasite; mortar zones; granoblastic. macroscopically: equigranular; inequigranular.

Sample numbers: (1) 791; (2) 792, 794, 797, 795, 796, 793; (3) 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808; (4) 809, 810, 811, 812; (5) 813, 814, 815; (6) 816, 817, 111720; (7) 818, 819; (8) 820

Table I – 6 Syn- and post-kinematic two-mica granites, aplites, pegmatites and granite porphyries

(1) fine-grained granite (pre-Barbanza); (2) Barbanza-types; (3) Muros-type; (4) Banza-type; (5) eastern and southern types; (6) Ruña; (7) aplites, pegmatites; (8) Arbos and (9) granite porphyries

Columns — constituent minerals: opaque/ore minerals; zircon; monazite/xenotime; apatite; fluorite; titanite; rutile; anatase/brookite; tourmaline; garnet; beryl; clinozoisite/epidote; sillimanite; biotite; chlorite; muscovite; sericite; quartz; alkali feldspar; plagioclase; saussurite. quartz: drops and small equidimensional inclusions; h.t. quartz; main generation: strained; dimensional preferred orientation; main generation: primary crystalline (xenom); recrystallized (mosaic/polygonal); late quartz. plagioclase: anorthite % (10, 20); twinning: (010) twins; (001) twins including pericline twins; multiple twins; zoning: normal; inverse; patchy or irregular; small and relatively early generation in alkali feldspar; relatively large (hypidiomorphic) crystals; albitization; myrmekite; decalcification. alkali feldspar: megacrystals or relative large hypidiomorphic crystals; carlsbad twins; cross-hatching; perthite. biotite: reddish brown; (dark) brown; small and relatively early. muscovite: late stage (lepidoblasts). zircon: sedimentary zircon (often as inclusions); idiomorphic zircon. apatite: relatively large idiomorphic to hypidiomorphic; small needles in feldspar and quartz. fabric: unstrained rock; deformed, Fs and/or Fs; strongly deformed, mainly Fs; phyllonitic/mylonitic; mortar zones; completely mylonitized (Fs). macroscopically: equigranular; inequigranular; aplite; pegmatite.

Sample numbers: (1) 843; (2) 821, 822, 823, 824; (3) 825, 826, 827, 828, 829; (4) 830, 831; (5) 832, 833, 834, 835, 836, 837, 838, 842; (6) 839, 840, 111463; (7) 844, 845, 846, 847, 848, 849, 850, 851, 852, 853; (8) 854, 855, 856, 857; (9) 858, 859


SAMPLE MAP
OF THE AREA AROUND NOYA
SCALE 1:50 000
Numbers and Localities of the described hand-specimens
Samples from C.E.S. Arps
The hand-specimens are numbered from St.141678 to St.141864; the prefix 141 is omitted on the map.
Other samples:
W.P.F.H de Graaff
A.F. Koster van Groos
I.B.H.M. Rubbens
Legend
river and coast
paved roads
geological boundary
fault
RIA DE NOYA Y MUROS
NOYA
RIA DE AROSA
Ocean
Atlantic
SPAIN
PORTUGAL
Noya
Puebla
Villagarcia
5°22' W of Madrid
5°18'
5°14'
5°10'
5°06'
42°55'
42°52'30"
42°50'
42°47'30"
42°45'
42°42'30"
42°40'
42°37'30"