PHOTOGRAPHS

1-55

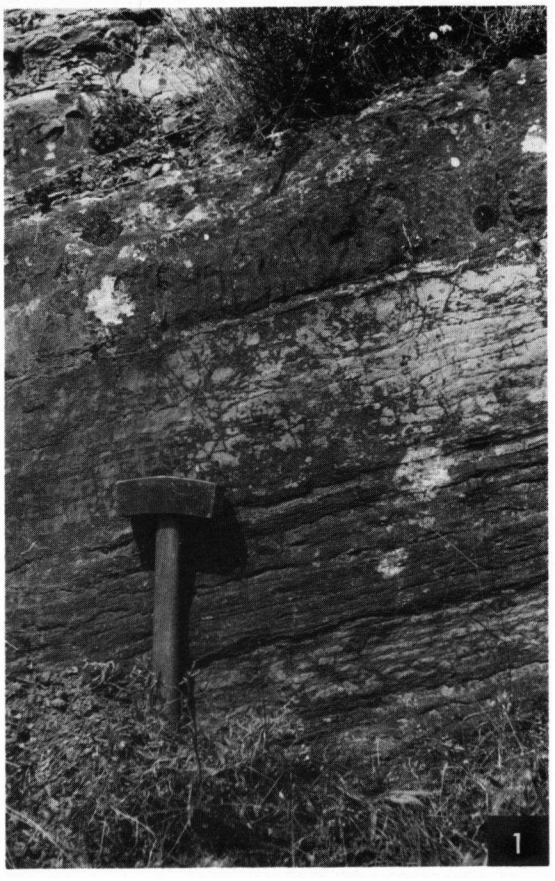
1. Villabellaco Limestone, nodular to wavy bedded becoming shaly towards the top of the photograph.
Locality: 71C185 (Encl. IV), N of Toranzo.

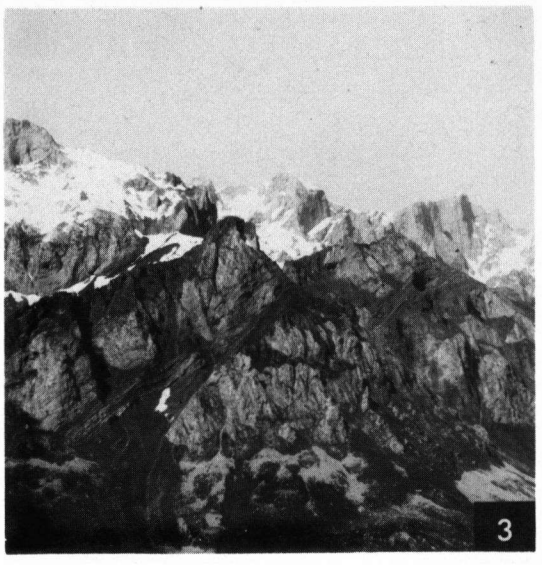
2. Caliza de Montaña Limestone, intraformational breccia exposed along the track leading to Peña Vieja, Picos de Europa area. The younging is to the top of the photograph.

3. Distinct tripartition of the Picos de Europa Limestone complex. Strongly dolomitized Caliza de Montaña Limestone overlain by the bedded and massive Picos de Europa Limestone. The limestone mass upper left belongs to the second nappe structure.
Locality: S boundary of the Picos de Europa, N of Tanarrio. The limestone strikes NE away from the observer.

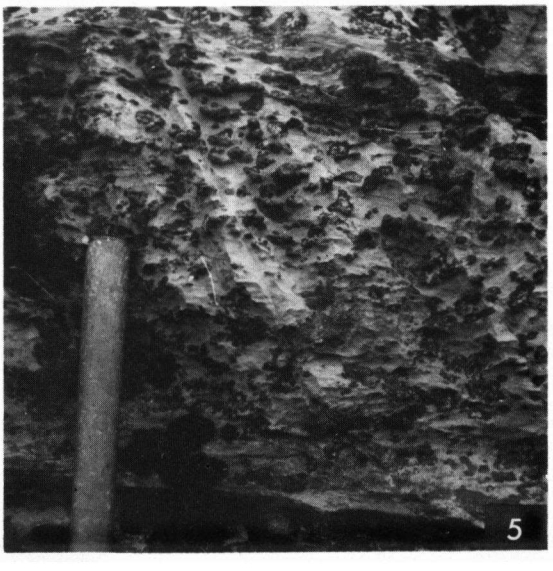
4. Flinty limestone in the bedded member of the Picos de Europa Formation.
Locality: 70183 (Encl. VII).

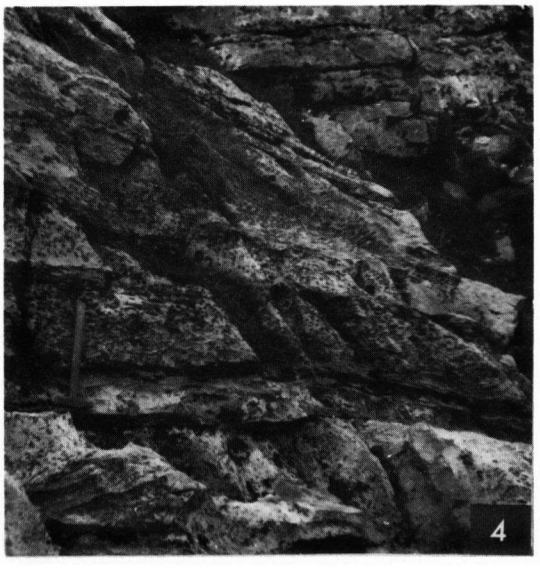
5. Detail of Photograph 4.


1


3


2


5


4

6. Pressure solution phenomena in the Picos de Europa Limestone.

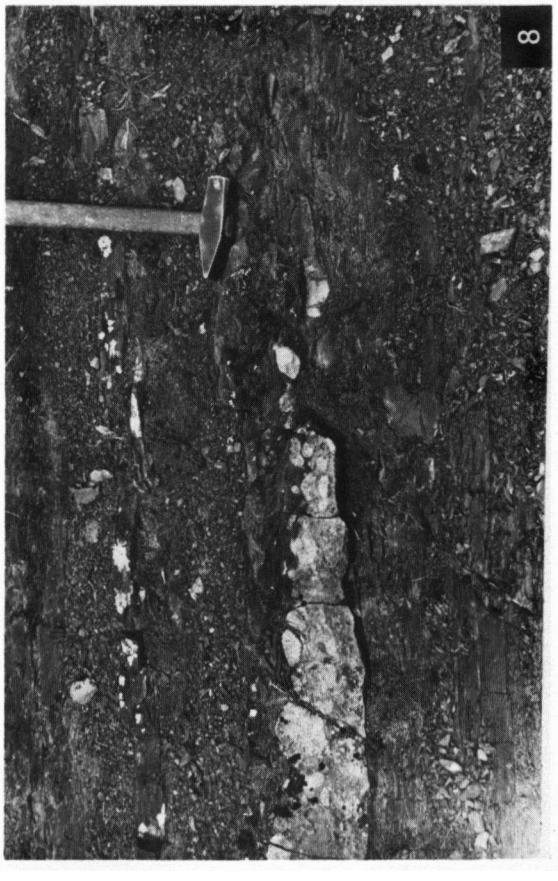
7. Characteristic lithology of the central part of the Lebeña Formation as developed immediately E of the Canal de San Carlos. Limestone breccias alternate with sandstone shale suites: unconformable contacts occur.

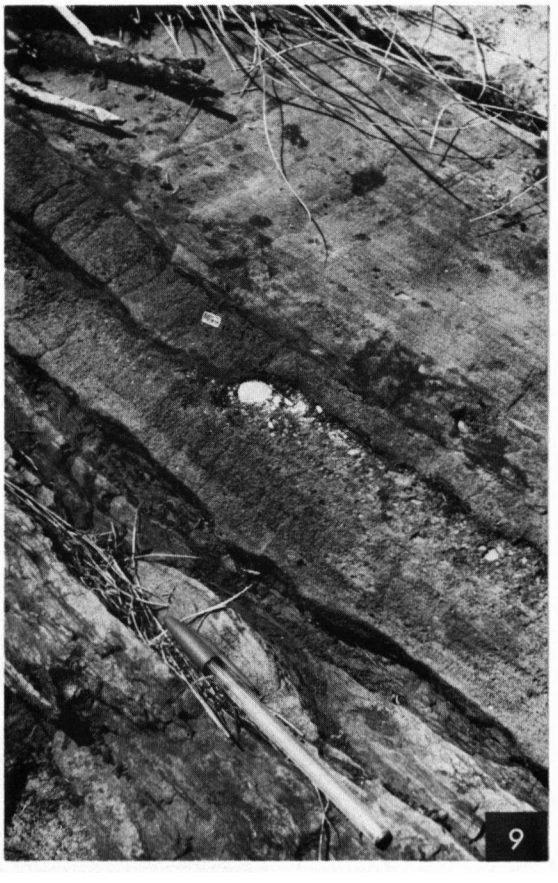
8. Lebeña Formation, calciruditic lenses and isolated limestone pebbles in limy shale. The younging is towards the top of the photograph.
Locality: ENE of Cabanes.

9. Lebeña Formation, in the central part of the development immediately E of the Canal de San Carlos. Coarse calcarenites and grits. The younging is towards the base of the photograph.


6


7

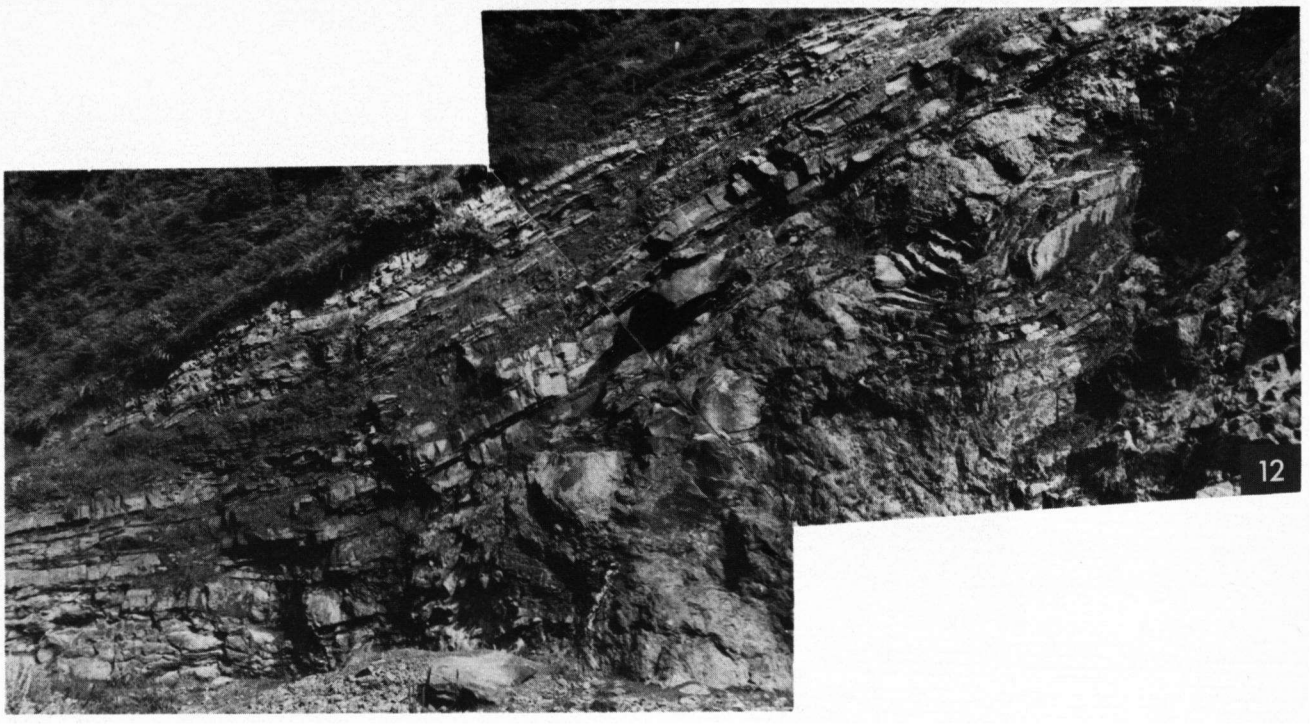

8

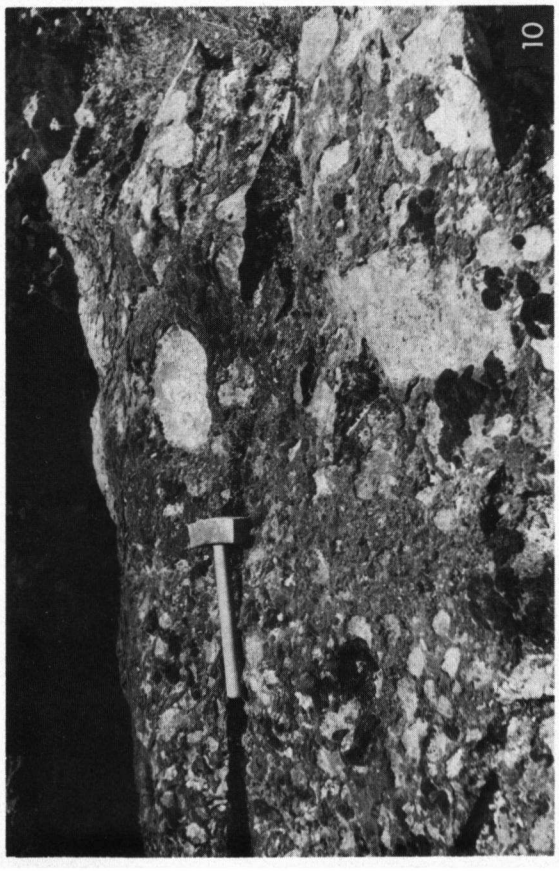

9

10. The Barcena Conglomerate. Angular limestone pebbles and boulders in a bedded fluxoturbidite.

11. The Barcena Conglomerate. Lenses of limestone conglomerate, grit and coarse sandstone constitute a bedded fluxoturbidite. Isolated pebbles and boulders occur in the grits and sandstones. The younging is towards the top of the photograph.

12. Olistostrome deposit at the top of the Barcena Conglomerate. Folded slabs of well-bedded dark micritic limestone and other large clasts float in a matrix of conglomerate. This sediment passes laterally into slumped turbidites. This wildflysch association is bounded at its top by an intraformational unconformity. The exposure has a height of 10 m.
Locality: 71 Bar (Encl. VII), along the road near Barcena.


12


10


11

13. Limestone olistolith of the Llaves limestone bed.
Locality: 7060 (Encl. VII).

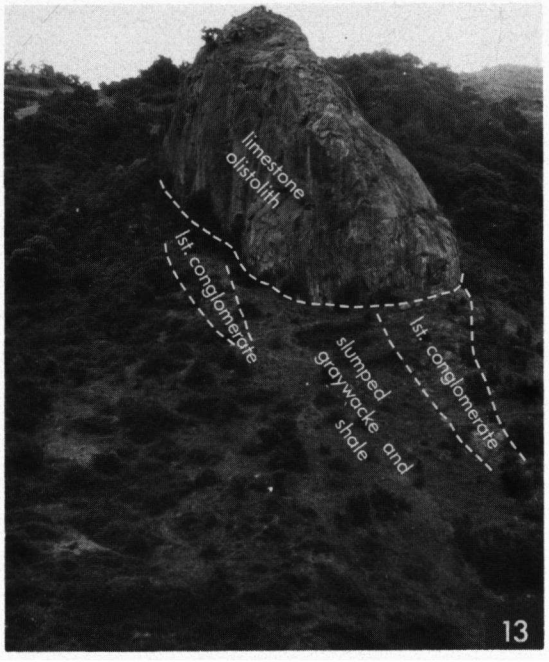
14. Western outlier of the Coriscao Olistostrome, conformably overlain by the Panda Limestone.
Locality: WSW of locality 7156 (Encl. VII).

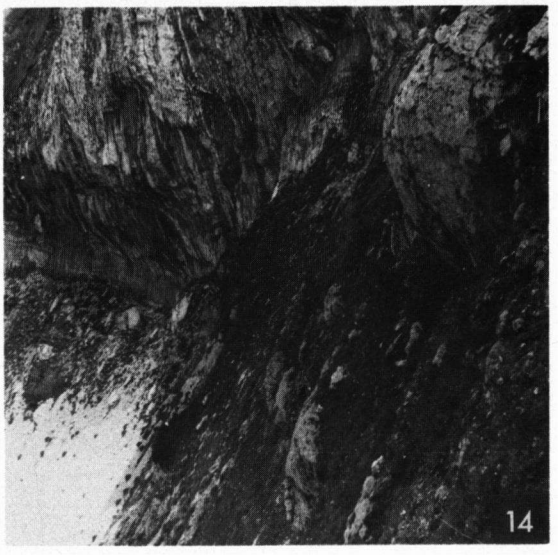
15. Limestone grit bed below the base of the Panda Limestone.
1) Coarse calcarenite to grit, structureless interval, loaded bottom, fining upward gradation.
2) Coarse calcarenite, current ripple laminated interval.
3) Calcarenite, parallel laminated interval.
4) Fine calcarenite to calcisiltite, finely parallel laminated interval.
Locality: Remoña syncline, the base of the Panda Limestone W of locality 7144 (Encl. VII).

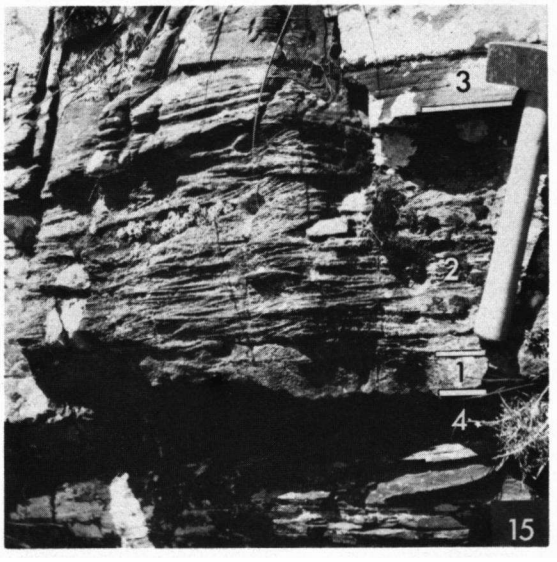
16. Detail of Photograph 15. The contact between the current ripple and parallel laminated intervals is sharp and locally erosive.

17. Detail of a limestone gritbed. Limestone pebbles of considerable proportions may occur in the gritbeds.
Locality: the same as for Photograph 15.

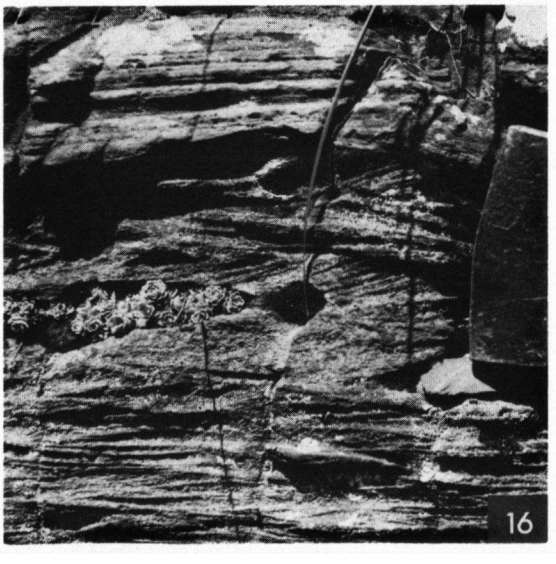
18. *Zoöphycos* burrows.
Locality: the same as for Photograph 15.


limestone olistolith
lst. conglomerate
slumped graywacke and shale
lst. conglomerate
13


14


3
2
1
4
15


17


16


18

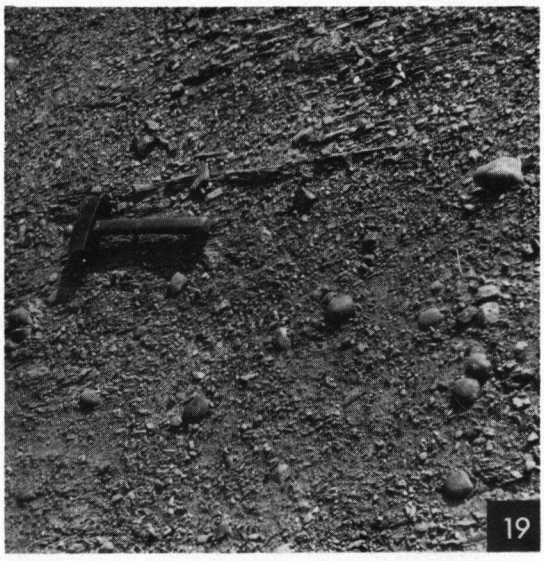
19. Bedoya Member. Mudstone with scattered well-rounded quartzitic pebbles.
Locality: halfway the track leading from Cillorigo Castro to Pendes.

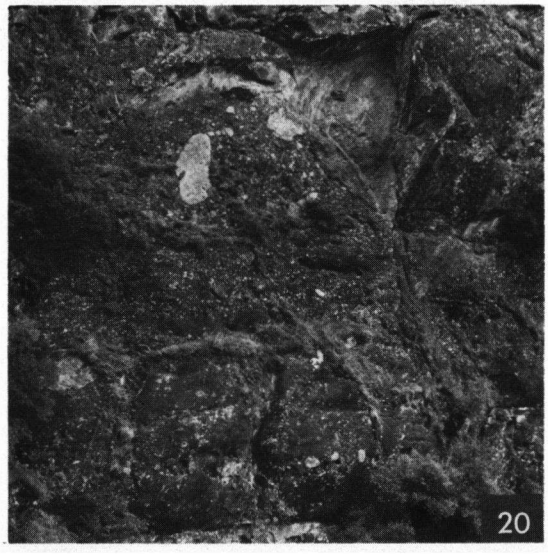
20. Cabezon Conglomerate as developed near Valmeo. A coarsely bedded fluxoturbidite.
Locality: W of locality L1 (Encl. VII).

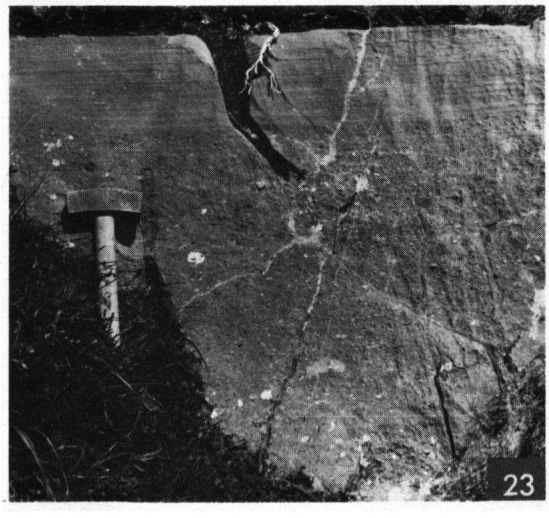
21. The Viorna Conglomerate in the Quiviesa valley N of La Vega de Liébana.

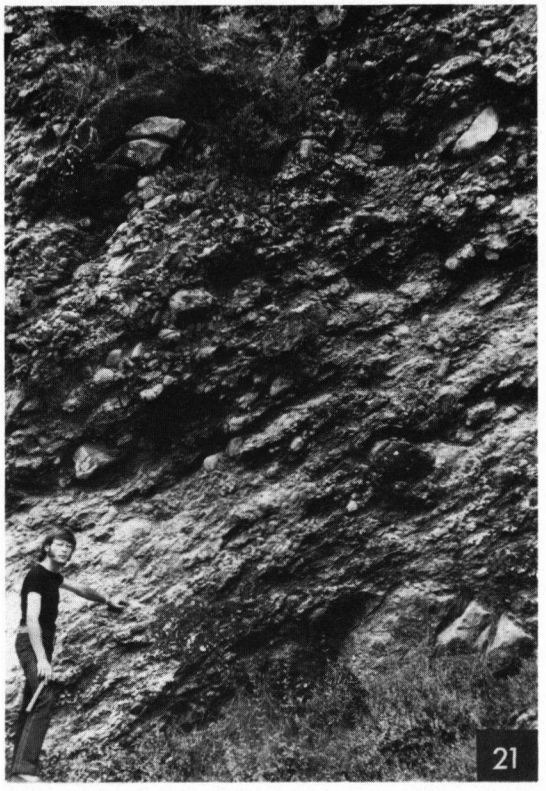
22. Detail of Photograph 21. Note the angular graywacke slices occurring as conglomeratic clasts.

23. A limestone grit bed situated about 15 m stratigraphically above the Panda Limestone in the Remoña syncline. Turbidite intervals A and B 1.


19


20


23


21


22

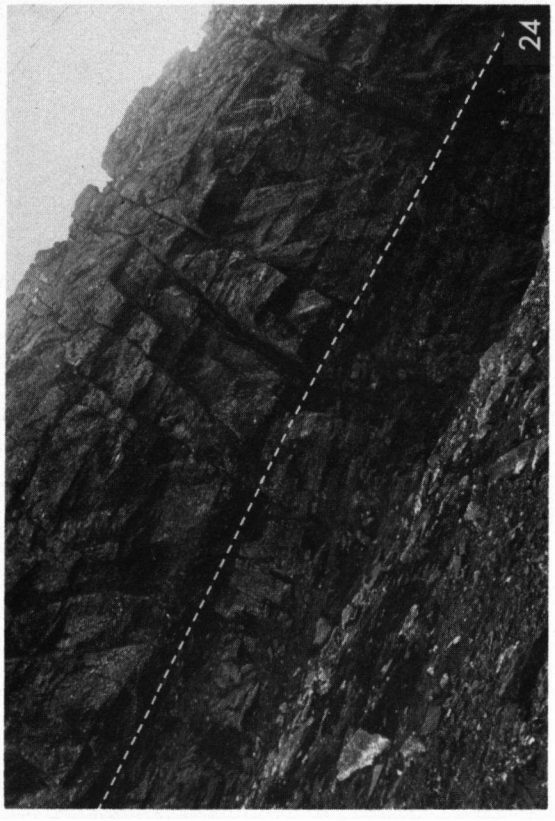
24. The basal conglomerate of the Triassic Nansa unit rests unconformably (indicated by broken line) on the red beds of the Labra Formation.
Locality: Sierra Sagra ridge, N slope, 1 km E of Peña Sagra.

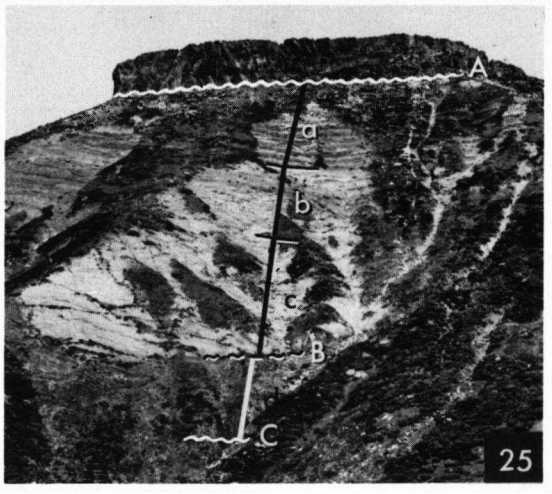
25. The type section of the Labra Formation on the SW slope of the Peña Labra (Encl. I).
A, B and C = unconformities
a = red beds
b = tuff member
c = volcanic agglomerate member
d = lahar member

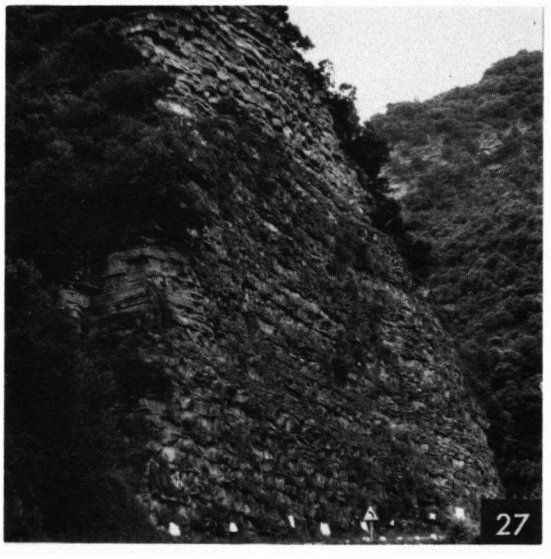
26. Unconformable contact between the red beds of the Labra Formation and the underlying breccious limestone conglomerate of the Lebeña Formation.
Locality: ESE of Lebeña.

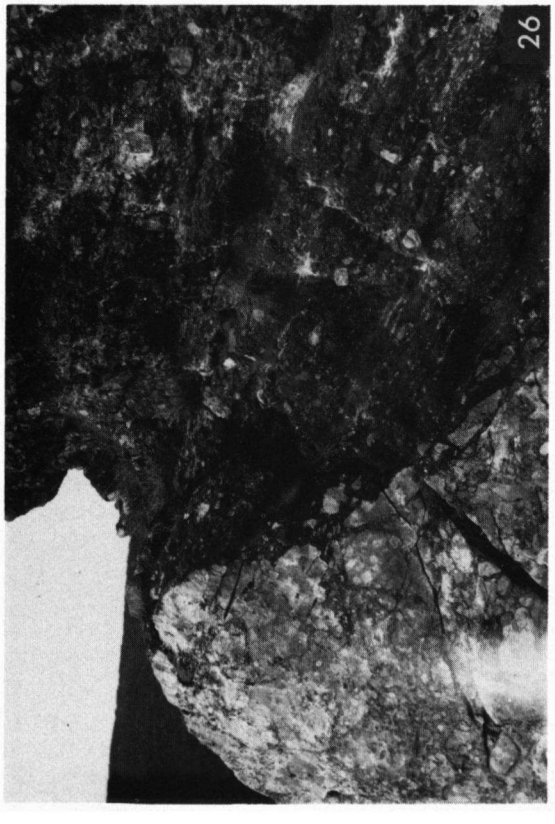
27. Sequence of thick 'top-truncated' turbidite beds consisting mainly of A and B intervals. Shale intercalations are thin to absent.
Locality: Potes–Piedrasluengas road, E of Los Cos.

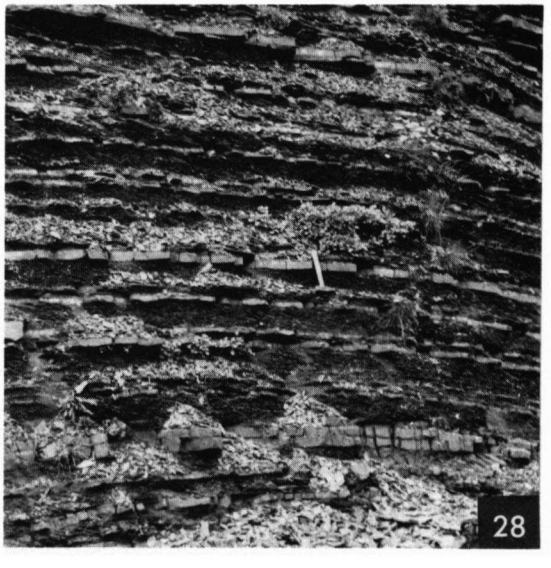
28. Sequence of 'bottom-truncated' turbidite beds consisting mainly of C and D intervals. The sequence consists for more than 50 % of shale.
Locality: headwaters of the Rio Saja.


24


A
a
b
c
B
C
25


27


26


28

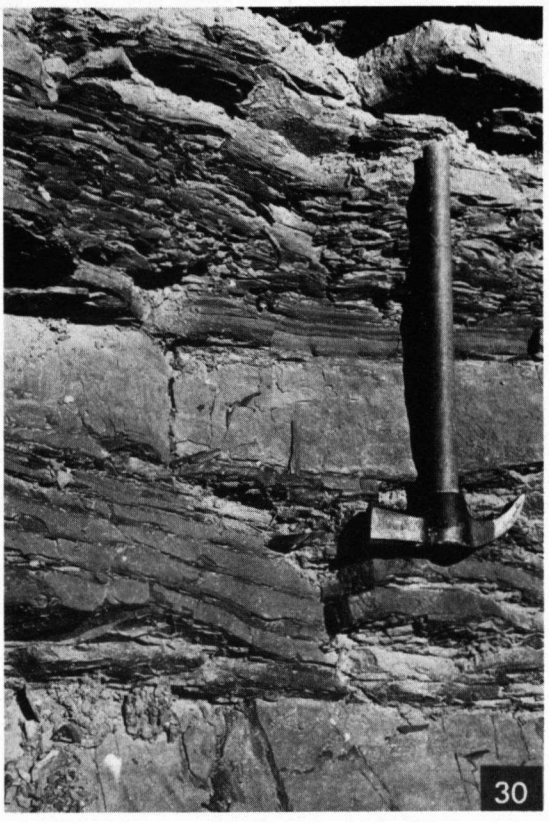
29. Alternation of 'mature' and 'immature' turbidites.
Locality: halfway the Lombraña–Tresabuela road, Polaciones.

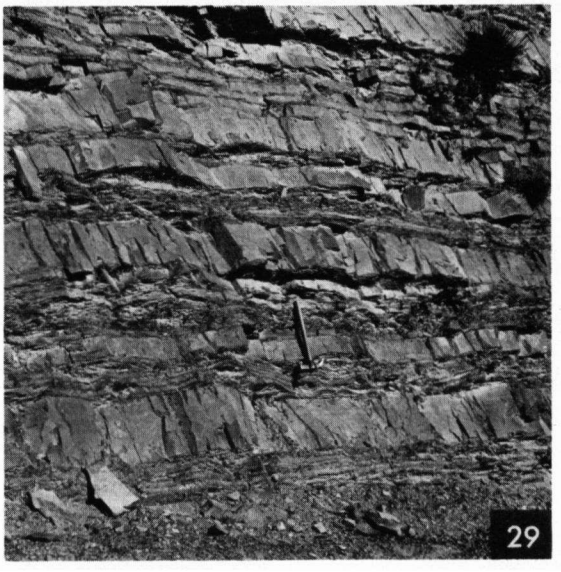
30. Detail of Photograph 29.

31. Sediment consisting of thin but continuous graywacke laminae alternating with shale. Graywacke laminae of isolated current ripples occur.
Locality: along the track from Camaleño to Tanarrio.

32. Interfering ripple pattern on the top of a turbidite (C interval).
Locality: halfway the road from Enterrias to Pembes.

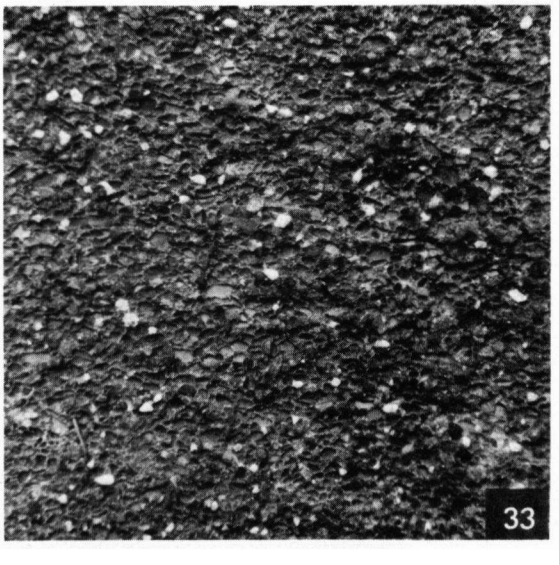
33. Structureless turbidite grit. The graywacke matrix is more resistant to weathering than the limestone clasts. The clasts are oriented with their longest axes subparallel to the bedding plane.
Enlargement: headwaters of the Rio Saja.


30


29


32


31

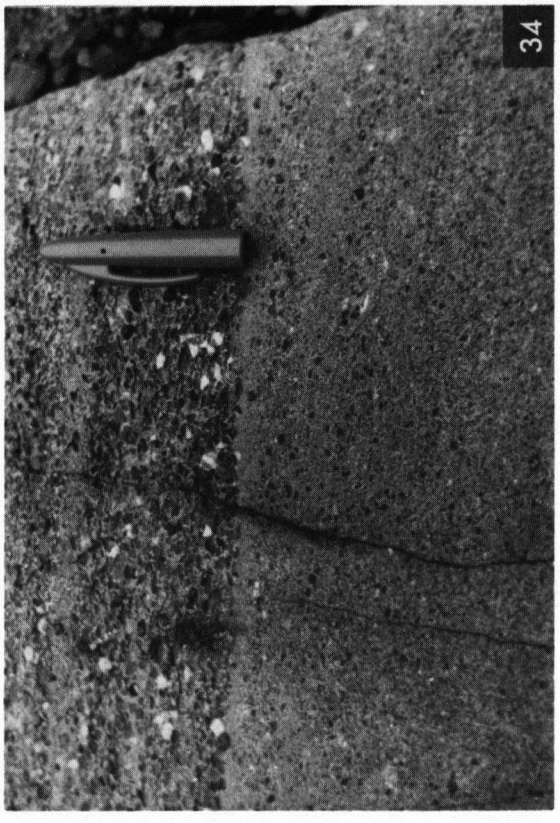

33

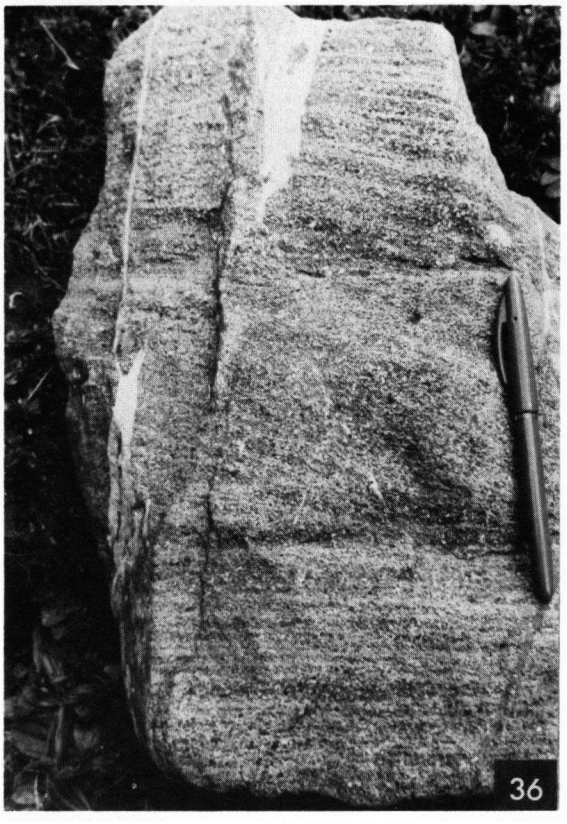
34. Multiple grading in a turbidite grit. Coarsening upward gradation occurs locally.
Locality: headwaters of the Rio Saja.

35. An example of coarsening upward gradation in the B 1–C 1 interval of a turbidite grit.
Locality: headwaters of the Rio Saja.

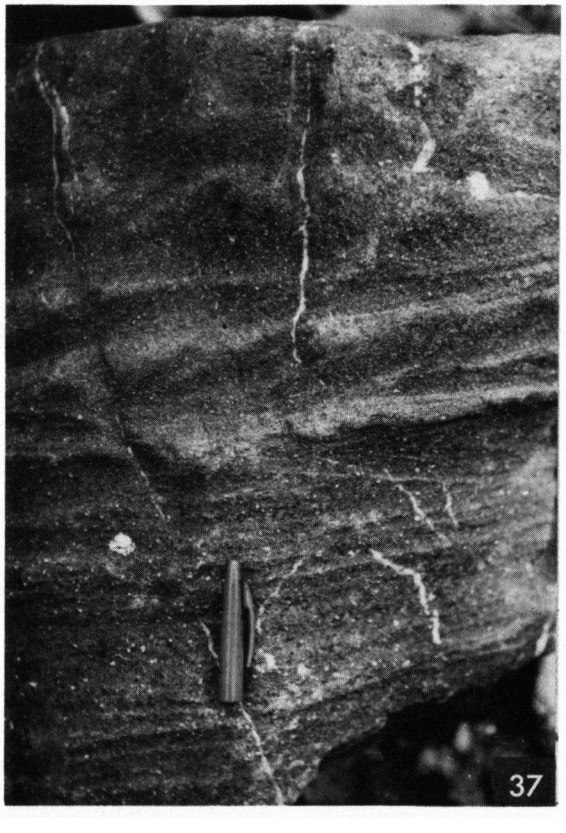
36. Turbidite grit; passage from the dune interval (C 1) to the intermediate interval of parallel laminations (B 2). Coarsening upward gradation is present but not so distinct.
Locality: headwaters of the Rio Saja.

37. Turbidite grit: passage from the B 2 interval to the interval of current ripple laminations (C 2).
Locality: headwaters of the Rio Saja.


34


36


35

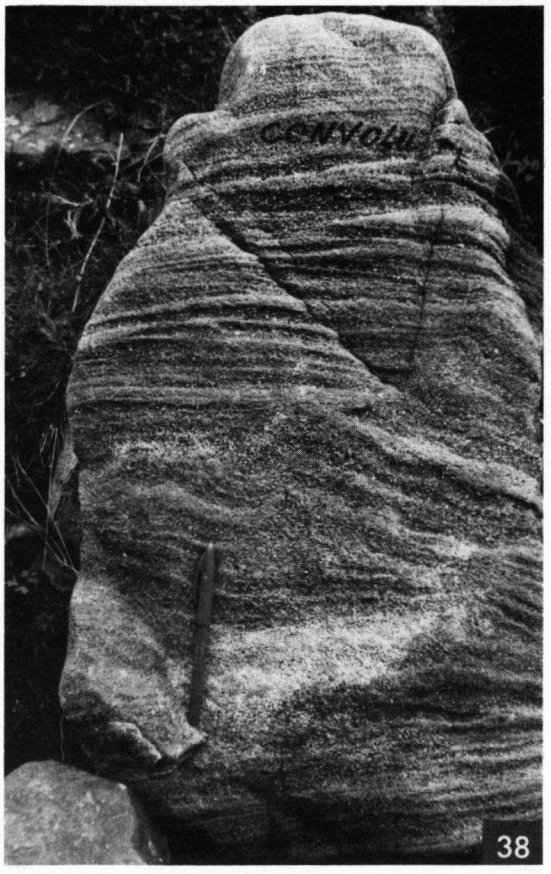

37

38. Synsedimentary deformation in a turbidite grit. Sediment-waves occur in a cross-bedded interval (dunes?) which passes upwards into parallel laminations. Note the unconformable cut-off.
Locality: headwaters of the Rio Saja.

39. Detail of Photograph 38.

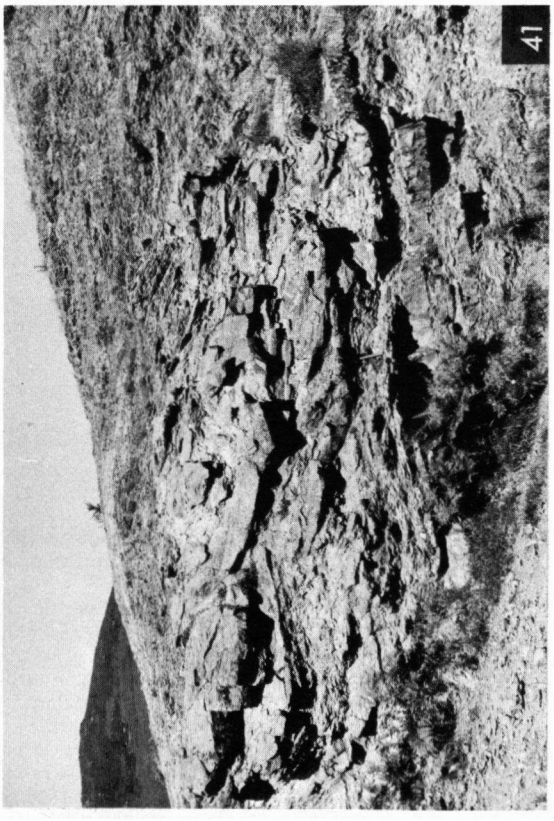
40. The Saques Conglomerate; vertical passage from a limestone conglomerate into a breccious limestone grit.
Locality: Pembes-Aliva track, near Las Portillas.

41. Sta. Eulalia Olistostrome; slumped turbidite beds, push-and-pull structures.
Locality: WNW of Toranzo.


38


39


40


41

42. Bedoya Olistostrome; slumped thin turbidite beds which consisted mainly of D intervals.
Locality: along the track to Pendes, E of locality 7178 (Encl. VII).

43. Potes turbidites; slump in which no original bedding can be distinguished.
Locality: Lombraña–Tresabuela road, Polaciones.

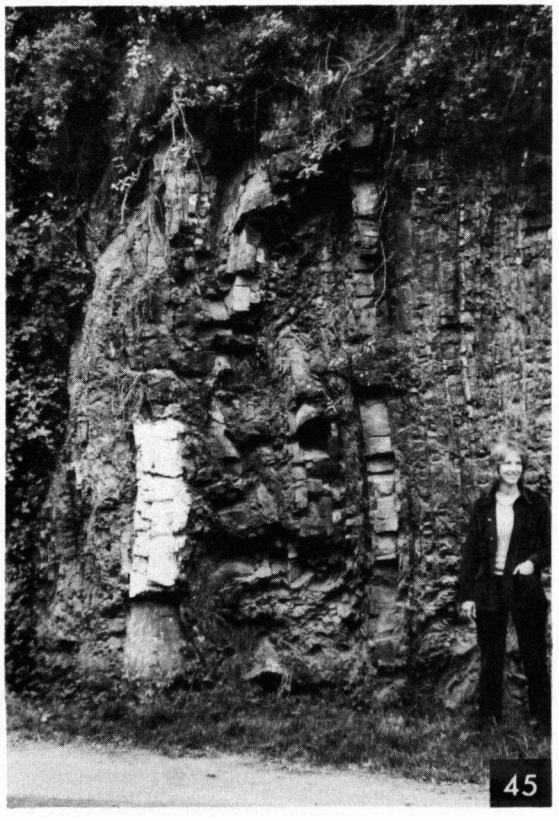
44. Buyon turbidites; gravitational slide folding in a slump.
Locality: Potes–Piedrasluengas road near la Venta Pepin.

45. Potes turbidites; slumped strata vertically bounded by undisturbed strata; the younging direction is to the left.
Locality: Deva road near San Pelayo.


42


43


44

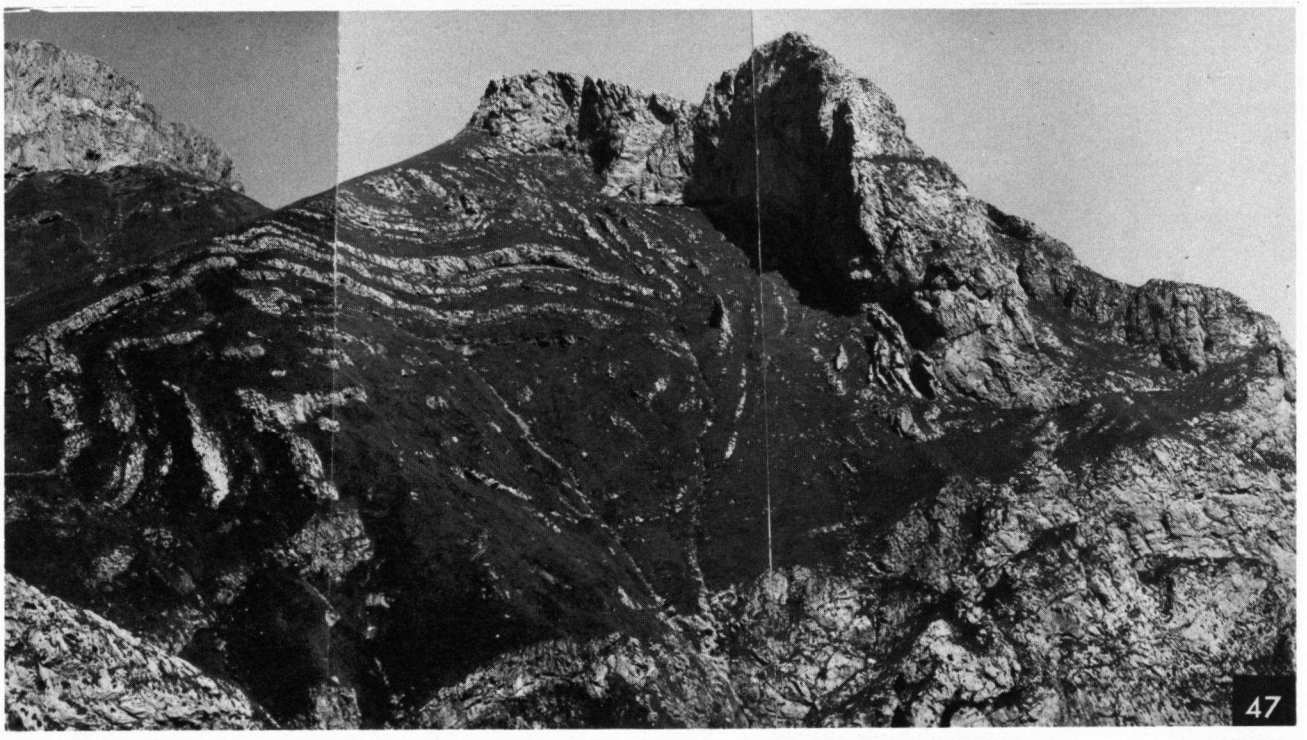

45

46. Detail of Photograph 45.

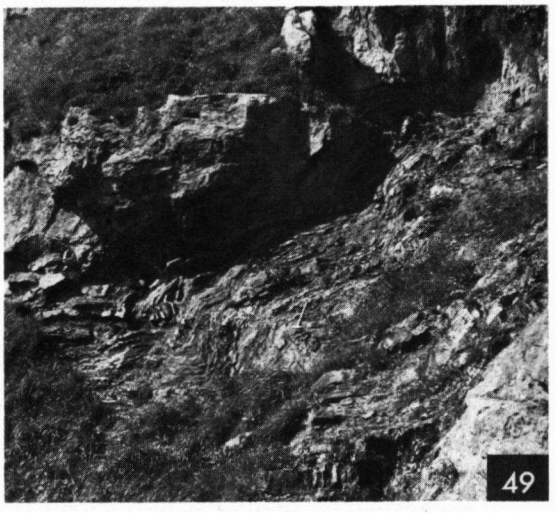
47. Gravitational folding and faulting in the Lebeña Formation, immediately E of the Canal de San Carlos. The observer is looking NE.

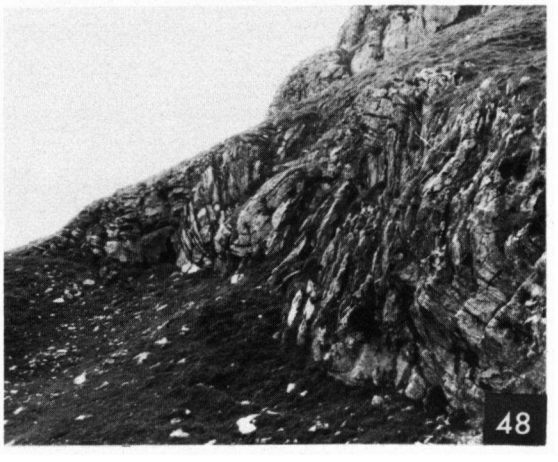
48. Alba Formation exposed along the first nappe front of the Picos de Europa, N of Puerto de Remoña. The nappe slide horizon has been folded with the platy limestones after the thrusting. The observer is looking W.

49. Lebeña Formation immediately E of the Canal de San Carlos. Cascade folds in the sandstone-shale sequence, subhorizontal thrust faults in the thicker limestone breccia beds.


47


46

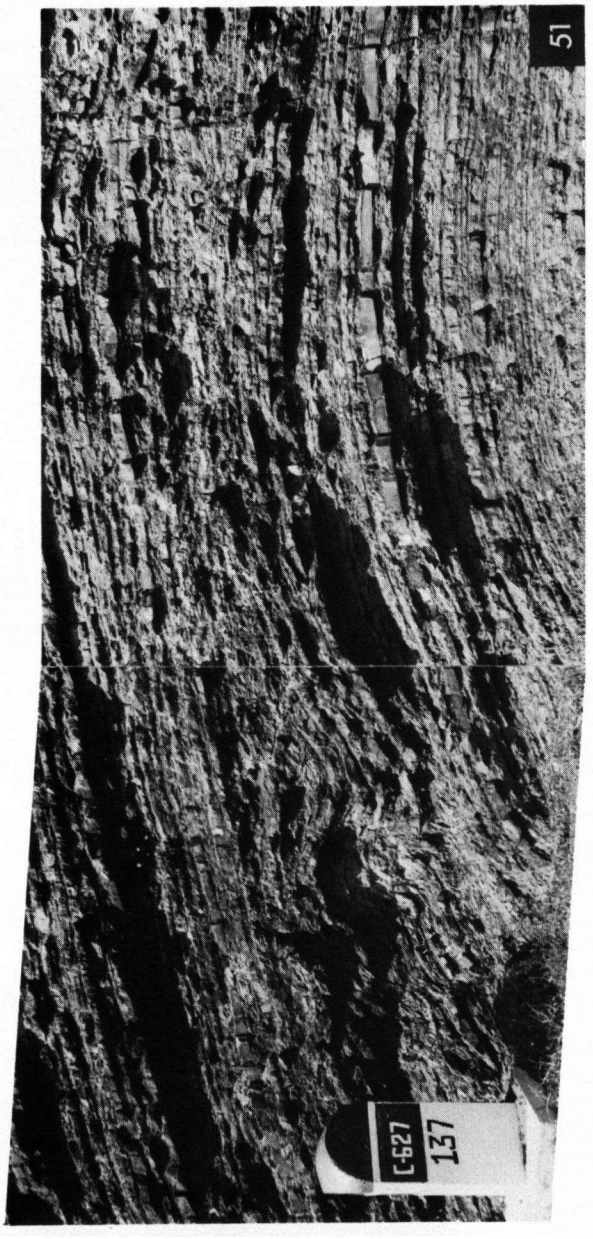

49


48

50. Buyon turbidites; example of a rotational slump. Scale the same as Photograph 51.
Locality: Potes–Piedrasluengas road about 100 m E of the junction with the road to Polaciones.

51. Buyon turbidites; example of a rotational slump.
Locality: same as Photograph 50.

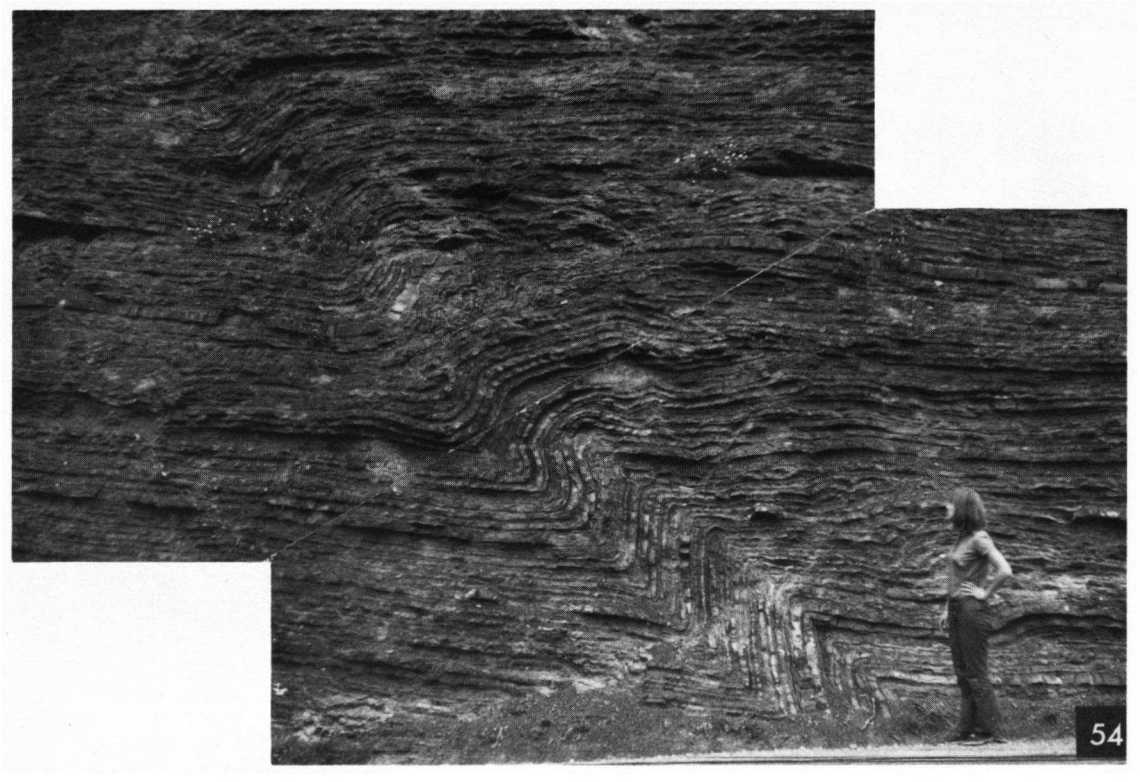

50


51
C-627
137

52. Tight chevron type cascade folds in the Potes turbidites.
Locality: 50 m N of Lon on the W bank of the brook.

53. Cascade folds in the Potes turbidites.
Locality: W bank of the Rio Quiviesa, E of Pico Viorna.

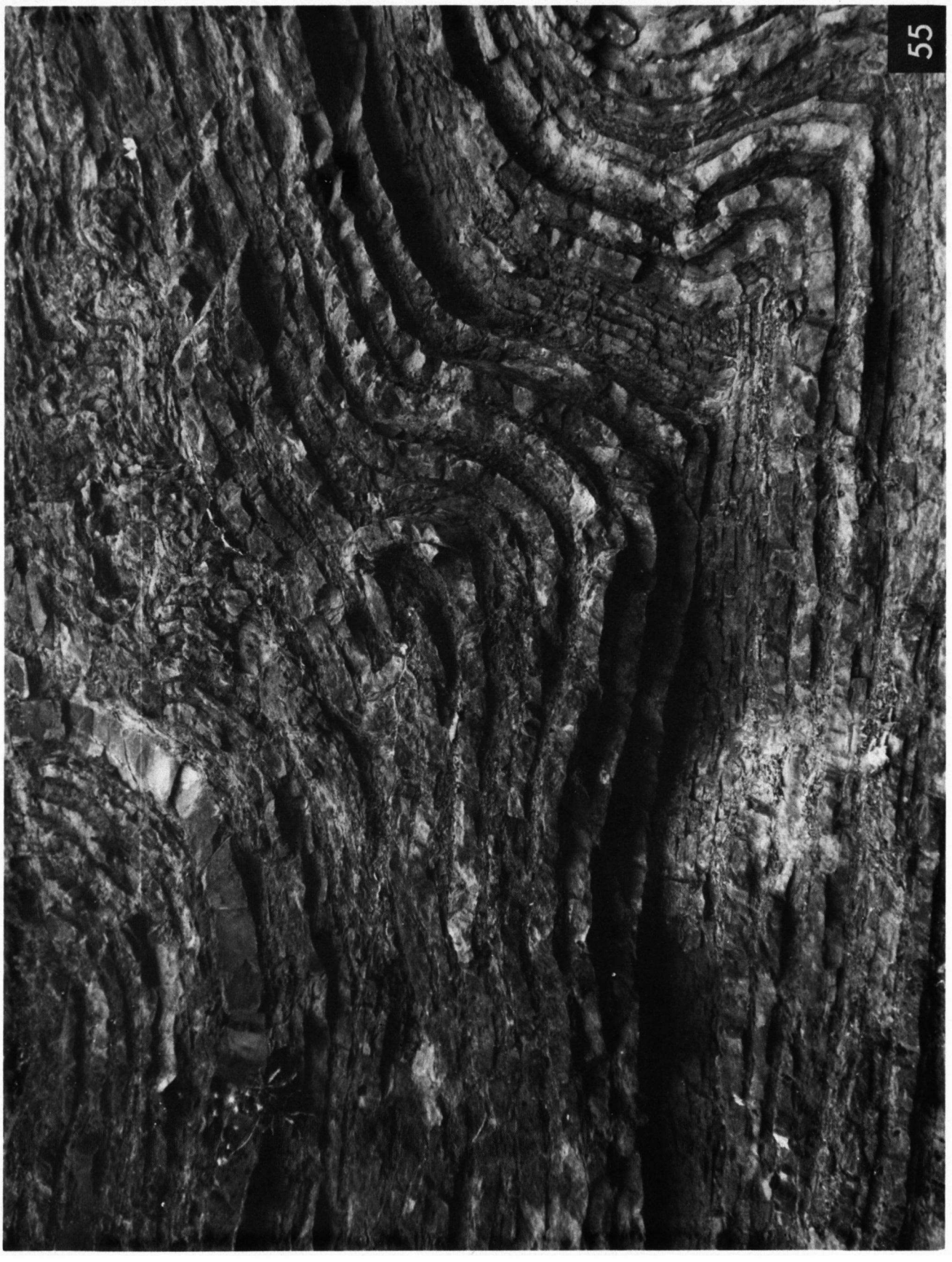
54. A kink band-like fold developed during a collapse. The fold flattens and disappears in the direction of the axial plane. Subsidiary collapse developed on the steep limb of the fold.
Locality: 50 m E of Photograph 51.


54


52


53

55. Detail of Photograph 54. Subsidiary collapse structures.


55

GEOLOGICAL MAP of the SOUTHERN CANTABRIAN MTS., SPAIN

SHEET MANSA - DEVA 1972

Prepared by K. MAAS

Published by the Geological Institute, Leiden University
Editors: D. Boschma and J.F. Savage

Scale 1:50.000

0 1 2 3 4 5 km

scree
consolidated scree
fluvio-glacial deposits
alluvial fill
moraine ridges
moraine scree walls
rock glacier

PICOS DE EUROPA AREA

Kassimovian?	lst., sh.,sst., congl.	Lebeña Fm.		Cea Group
Moscovian	mass.lst., sh., bedd.lst.	Picos de Europa Fm.	Aliva Fm.	Yuso Group
Bashkirian	lst.	Caliza de Montaña Fm.		Ruesga Group
Viséan	red lst.	Alba Fm.		
famennian?	calc.sst.	Ermita Fm.		

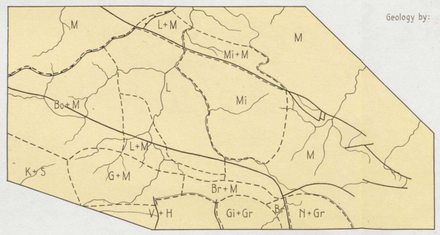
tectonic breccia
sandstone
normal position of strata
overturned position of strata
slump deformation
thrust fault, certain - probable
fault, certain - probable
unconform. boundary, observed - inferred
passing from unconformity in to sharp boundary where no unconformity was observed
strike and dip
strike and dip of overturned strata
a——a' type section

LIÉBANA, N. PISUERGA

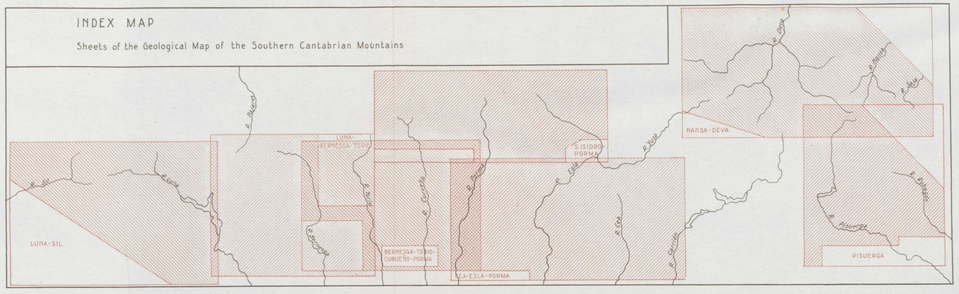
Jurassic ?	lst.	Tudanca unit		
Triassic	sst., sh. congl.	Mansa unit		
Permian	sst., sh. tuff volc. eggl.	Labra Fm.		
Stephanian C	sst., sh. congl.	Cordel unit		Cea Group
Stephanian A - Cantabrian - Westfalian D	lst. sst., sh. coal congl.	"Barruelo Fm."	Valdeon Fm. / S. Mames unit	
		Cea or Yuso; undefined		
Upper Moscovian	lst. sst., sh. lst.	Corisa Fm.	Pandatrave Fm.	Yuso Group
Lower - Upper Moscovian	congl., lst. sst., sh.	Lechada Fm.	Vañes Fm.	
Lower - Upper Moscovian	congl.	Curavacas Fm.		
		Yuso or Ruesga, no mappable boundary		
Lower Moscovian - Bashkirian	lst. sst., sh. congl.	Cervera Fm.		Ruesga Group
Bashkirian	lst. sh.	Cosgaya unit		
Viséan	red lst. sh.	Villabellaco Fm.		
Viséan - Tournaisian	sh. chert	Vegamián Fm.		
Older Palaeozoic		Undifferentiated		

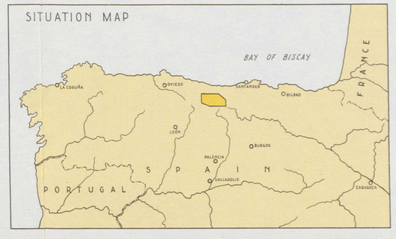
famennian	red lst., sh.	Vidrieros Fm.	
famennian	quartzitic sst.	Murcia Fm.	
Frasnian	red lst.	Cardaño Fm.	
Givetian	lst., sh.	Gustalapiedra Fm.	
Eifelian	lst., sh.	Abadía Fm.	

Granite
Intrusive igneous rock
Extrusive igneous rock

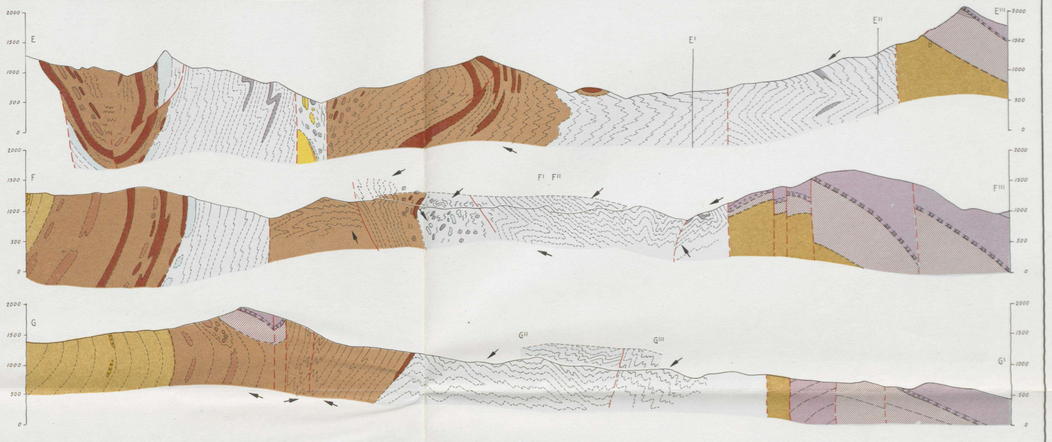


Geology by:
Bo = W.K. Boehmer 1965 int. rep.
Br = A. Breimer 1956 int. rep.
G = G.J.B. Germs 1966 int. rep.
Gi = A.C. van Ginkel 1955 int. rep.
Gr = W.J.E. van de Graaff 1970 publ.
H = J.A. van Hoeflaken 1958 int. rep.
K = P. Kamerling 1962 int. rep.
L = R.W. Lanting 1966 int. rep.
M = K. Maas 1968 int. rep. 1972 publ.
Mi = S.K. Miedema 1966 int. rep.
N = M.H. Nederlof 1959 publ.
S = J.F. Savage 1961 M.Sc.th. 1966 publ.
V = J. van Veen 1965 publ.





Topografía tomada de las Hojas 56-57 y 81-82 del mapa de España del Instituto Geográfico y Catastral (Escala 1 : 50 000). Realizado de acuerdo con la Comisión Nacional de Geología. 1ª edición autorizada por el Consejo Superior Geográfico en 8-8-72.



STRUCTURAL CROSS-SECTIONS THROUGH THE NANSA-DEVA REGION

SCALE 1:50.000

0 1 2 3 4 5 km

with adaptations from:
G.J.B. Germs (1966)
P. Kamerling (1962)
R.W. Lanting (1966)
S.K. Miedema (1966)
J.F. Savage (1961, 1967)

bedding plane and/or lithotope boundary:
- confirmed by observations
- inferred from observations
- hypothetic

fault:
- confirmed
- inferred
- hypothetic

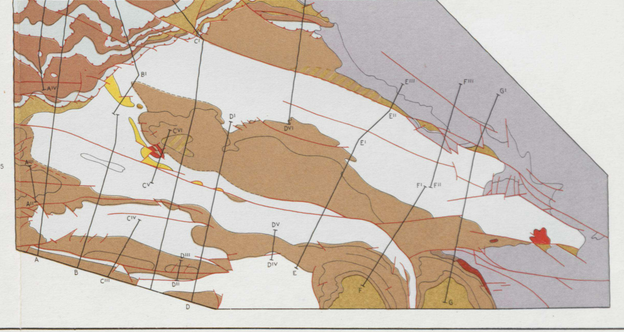
unconformity:
- confirmed
- inferred
- hypothetic

direction of younging

for other symbols see legend of the Nansa-Deva sheet

- LABRA-TUDANCA
- CEA GROUP
- YUSO GROUP
- RUESGA GROUP
- CARDAÑO-VIDRIEROS
- IGNEOUS ROCKS MURCIA

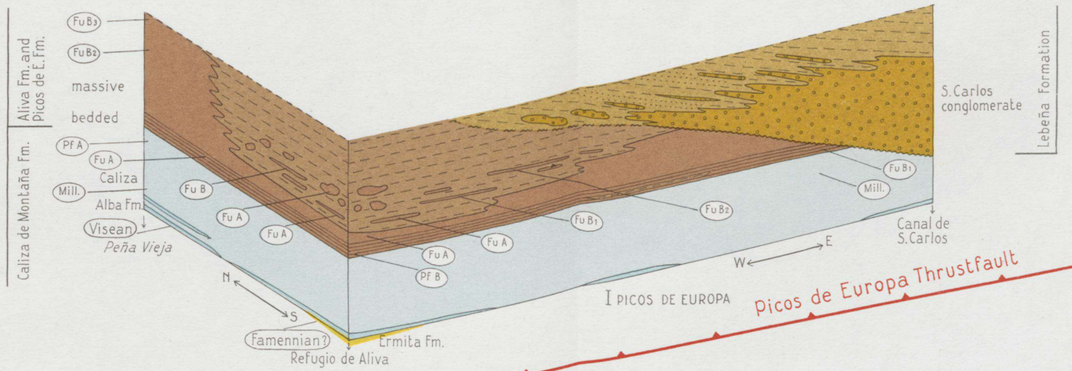
A — A' SECTION LINE



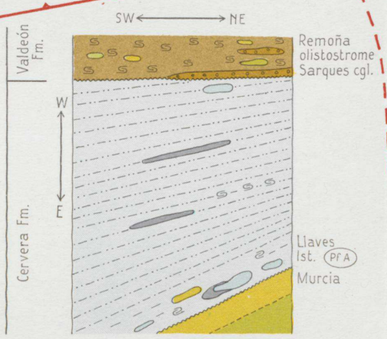
SPATIAL RELATIONS

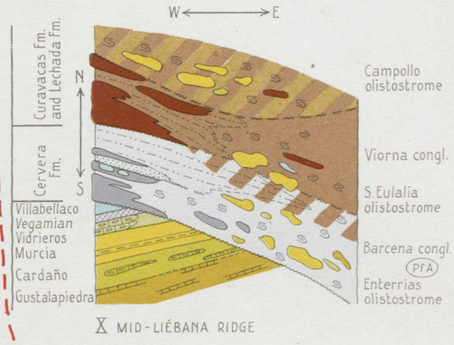
OF THE CARBONIFEROUS LITHOSTRATIGRAPHIC UNITS OF LIÉBANA AND THE SURROUNDING AREAS BY MEANS OF TEN COMPOSITE LITHOSTRATIGRAPHIC COLUMNS AND ONE BLOCKDIAGRAM

Vertical scale: 1:25.000 Horizontal scale: variable

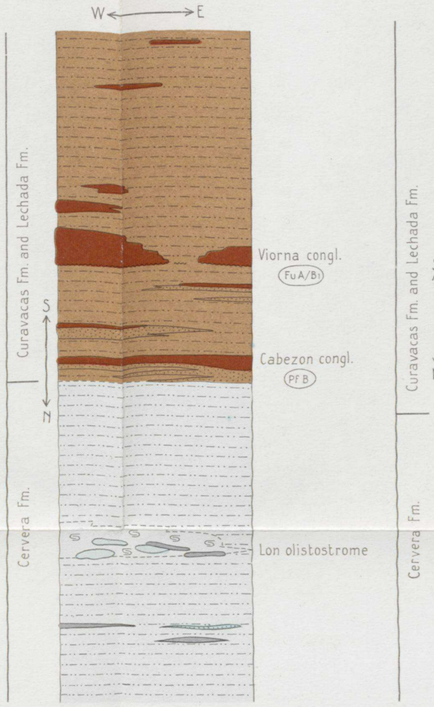


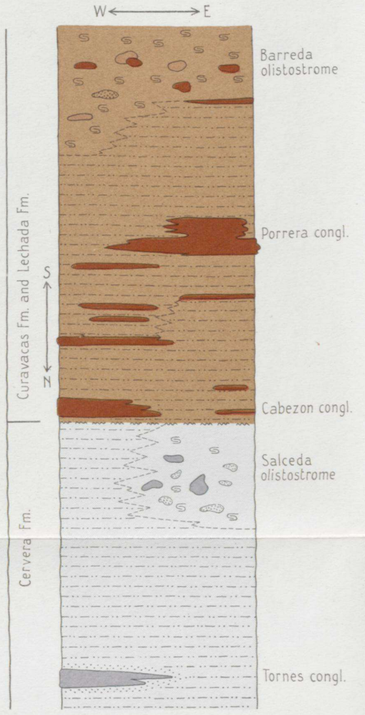
Legend identical to the legend of the Nansa-Deva sheet

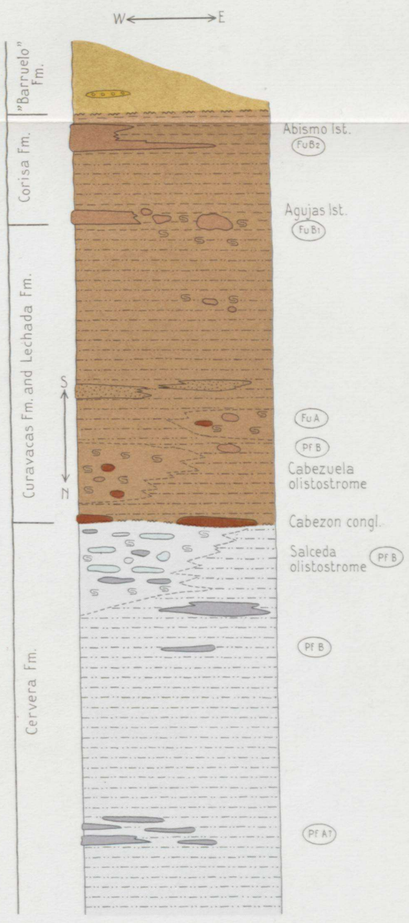




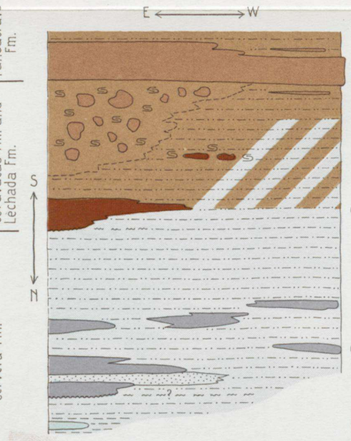
Mid-Liébana Ridge



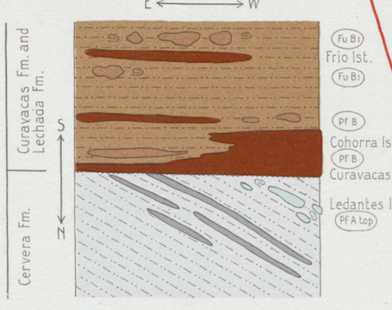


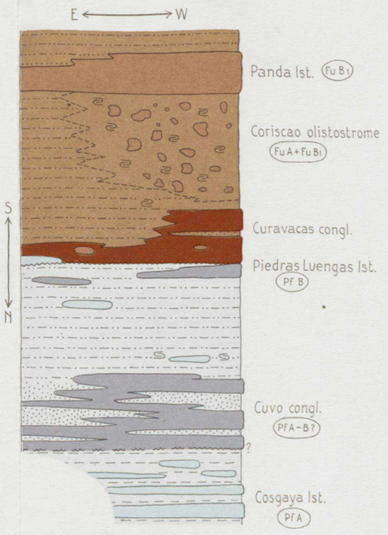


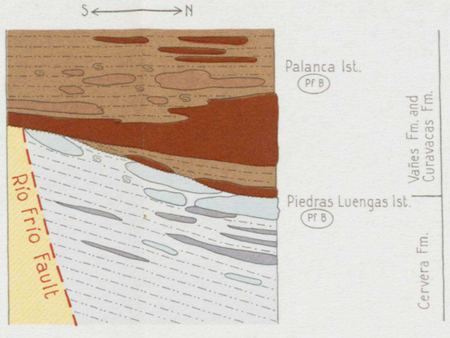
Redondo Fault

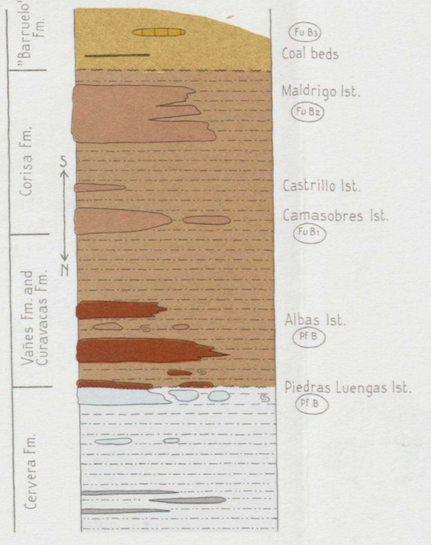


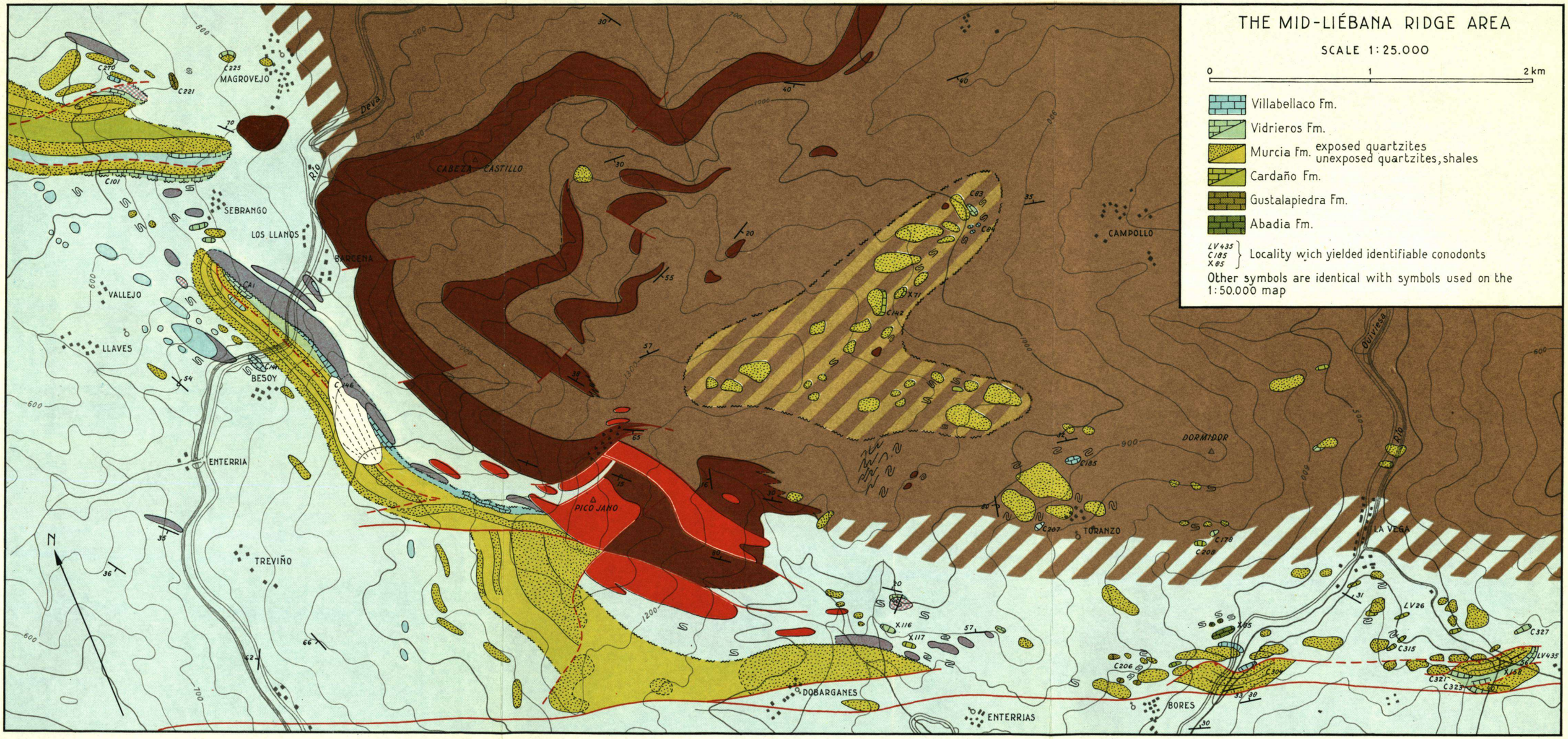
Orcadas Fault



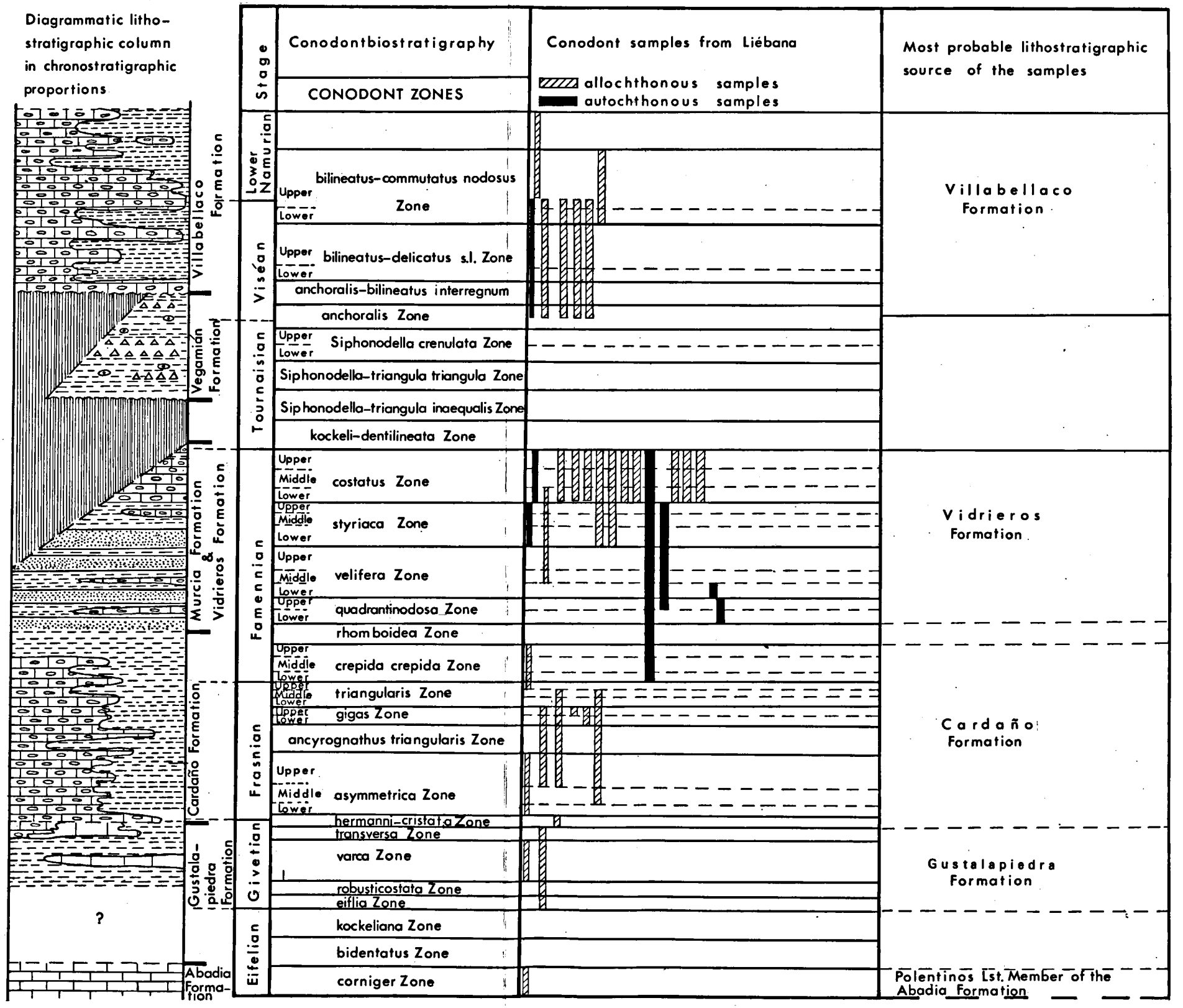







THE MID-LIÉBANA RIDGE AREA
SCALE 1:25.000
0
1
2 km
Villabellaco Fm.
Vidrieros Fm.
Murcia Fm. exposed quartzites
unexposed quartzites, shales
Cardaño Fm.
Gustalapiedra Fm.
Abadia Fm.
LV435 C185 X85 Locality wich yielded identifiable conodonts
Other symbols are identical with symbols used on the 1:50.000 map
MAGROVEJO
SEBRANGO
LOS LLANOS
BARCENA
VALLEJO
LLAVES
BESOY
ENTERRIA
TREVIÑO
CABEZA CASTILLO
PICO JANO
CAMPOLLO
DORMIDOR
TURANZO
LA VEGA
DOBARGANES
ENTERRIAS
BORES
Deva
Río
Ouviesa
N

Middle-Upper Devonian and Lower Carboniferous nodular limestone—shale facies in Liébana
A diagram of reconstructed chronostratigraphy



CHRONOSTRATIGRAPHIC RELATIONS
of the Carboniferous lithostratigraphic units of Liébana and the surrounding areas
(mainly based on fusulinid biostratigraphy)

CARBONIFEROUS — Upper / Lower

Westeuropean subdivision: Stephanian (A, B, C) — Westfalian (A, B, C) — Namurian (A, B, C) — Tournaisian — Viséan

Russian subdivision: Gzhelian — Kasimovian — Moscovian — Bashkirian

Fusulinid zones: Protriticites — Fusulinella (A, B, C, D) — Triticites — Profusulinella — Millerella — Pseudostaff. ant. subzone

Fusulinid subzones: 1 — 2 — 3

I Picos de Europa

?

Lebeña Formation

San Carlos congl. M.

Picos ls. F. (massive member) — Alva sh. Formation

Picos ls. F. (bedded m.)

Caliza de Montaña Formation

Alba F.

Villabellaco Formation assumed

Vegamián F. assumed

II N. Liébana

?

San Mames unit

Bedoya ostr. M. — Viorna cgl. M.

Lechada F. (Buyon turbidites) + Curavacas Formation

Cabezon cgl. M.

Lon olistostrome Member

Cervera (Poles turbidites) Formation

?

Villabellaco Formation assumed

?

Vegamián F. assumed

III E. Liébana

?

Barredo olistostr. Member

Porrera cgl. M.

Lechada F. (Buyon turbidites) + Curavacas Formation

Solceda olistostrome Member

Tornes congl. Member

Cervera (Poles turbidites) Formation

?

Villabellaco Formation assumed

?

Vegamian F. assumed

IV Polaciones – Redondo

?

Cordel unit

?

Carros ls. M.

"Barruelo Formation"

Abismo ls. M.

Corisa F.

Agujas ls. M.

Lechada F. (Buyon turbidites) + Curavacas Formation

Cabezuela ostr. M.

Solceda ostr. M.

Cervera (Poles turbidites) Formation

?

Villabellaco Formation assumed

?

Vegamián F. assumed

V Casavegas – Vendejo

?

Lores ls. M.

Casavegas coalbeds

"Barruelo Formation"

Maldrigo ls. M.

Camasobres ls. M.

Valles Formation + Curavacas Formation

Albas ls. M.

Piedras Luengas ls. M.

Cervera (Upper Deva turbidites) Formation

?

Cosgaya ls. unit possible

?

Vegamián F. assumed

VI Dobres – Caloca

?

Ranas ls. M.

Corisa F. — Curavacas F.

Valles Formation + Curavacas Formation

Polanca ls. M.

Valles F. + Curavacas F.

Piedras Luengas ls. M.

Cervera (Upper Deva turbidites) Formation

?

Cosgaya ls. unit possible

?

Vegamián F. assumed

VII Ledantes – Rio Frio – Zamburria

?

Frio ls. M.

Lechada Formation + Curavacas Formation

Cohorra ls. M.

Ledantes ls. M.

Cervera (Upper Deva turbidites) Formation

?

Cosgaya ls. unit

?

Vegamián F. assumed

VIII Vada – Cosgaya

?

Brañas ls. M.

Panda ls. M. — Panda-Irave Form.

Panda ls. M.

Corriscao ostr. M.

Lechada Formation + Curavacas Formation

Cervera (Upper Deva turbidites) Formation

Cuvo congl. sst. M.

Cosgaya ls. unit

?

Vegamián F. assumed

IX Las Ilces – Espinama

?

Brañas ls. M.

Panda ls. M. — Panda-Irave Form.

Panda ls. M.

Corisa ostr. M.

Lechada Formation + Curavacas Formation

Cervera (Upper Deva turbidites) Formation

Cuvo congl. sst. M.

Cosgaya ls. unit

?

Villabellaco Formation assumed

?

Vegamián F. assumed

X Mid – Liébana ridge

?

Campollo ostr. M.

S. Eulalia ostr. M.

Lechada F. + Curavacas F.

Lechada Formation + Curavacas Formation

Cervera (Upper Deva turbidites) Formation

Barcena congl. Member

Cervera Enterrios olistostrome Member (Poles turbidites) Formation

Villabellaco Formation

Vegamian Formation

XI Llaves – Sarques

?

Remoña ostr. M. — Valdeon Form.

Sarques congl.

Llaves ls. bed

Cervera Formation (Poles turbidites)

Vegamian Formation

TYPE SECTION OF THE LABRA FORMATION

m: 575, 550, 500, 450, 400, 350, 338, 300, 250, 203, 200, 150, 100, 68, 50, 0

Nansa unit — TRIASSIC

red beds

tuff member — FORMATION

volcanic agglomerate member

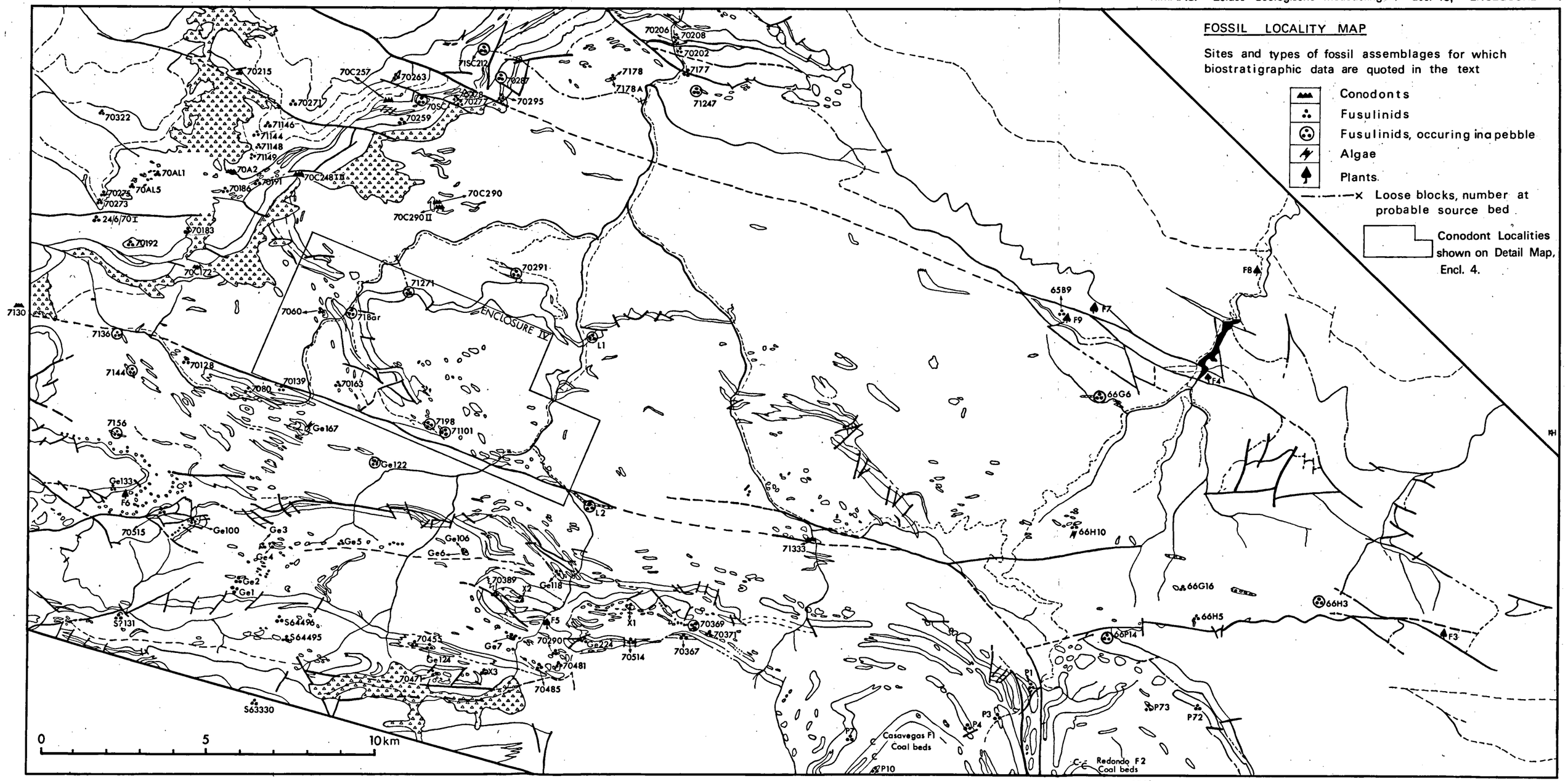
lahar member — LABRA

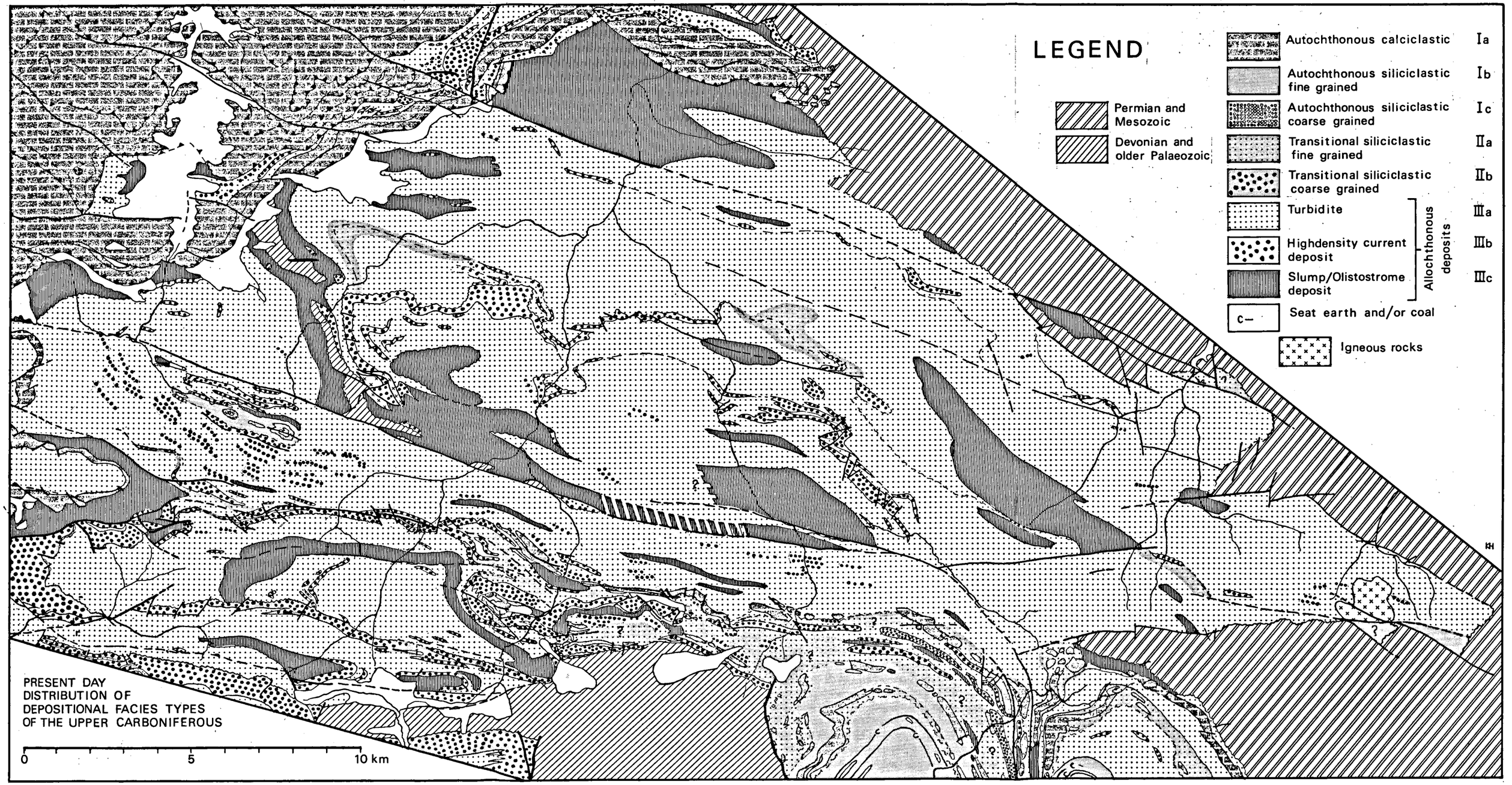
Lechada Formation

PERMIAN

CARBONIFEROUS

- volcanic agglomerate
- tuff
- reworked tuff
- tuffaceous shale
- tuffaceous sand
- calcite concretion
- unconformity
- gradual transition
- parallel lamination
- cross-bedding
- erosive channel fill
- mudflow structures


FOSSIL LOCALITY MAP
Sites and types of fossil assemblages for which biostratigraphic data are quoted in the text
Conodonts
Fusulinids
Fusulinids, occuring in a pebble
Algae
Plants
Loose blocks, number at probable source bed
Conodont Localities shown on Detail Map, Encl. 4.
ENCLOSURE IV
Casavegas F1 Coal beds
Redondo F2 Coal beds
0
5
10km


LEGEND
Permian and Mesozoic
Devonian and older Palaeozoic
Autochthonous calciclastic Ia
Autochthonous siliciclastic fine grained Ib
Autochthonous siliciclastic coarse grained Ic
Transitional siliciclastic fine grained IIa
Transitional siliciclastic coarse grained IIb
Turbidite IIIa
Highdensity current deposit IIIb
Slump/Olistostrome deposit IIIc
Allochthonous deposits
c– Seat earth and/or coal
Igneous rocks
PRESENT DAY DISTRIBUTION OF DEPOSITIONAL FACIES TYPES OF THE UPPER CARBONIFEROUS
0 5 10 km
KH