CONTAINS

PULLOUTS

APPENDIX I. The samples studied.

The samples studied are listed below in three sections.

1. Ordovician field samples.
2. Silurian-Lower Devonian field samples.
3. Oum Doul-1 well core samples.

Within each section, samples are listed alpha-numerically.

The topographic maps cited are those from the 1:100 000 Cartes du Maroc series (Appendix II) and the geological map sheets have been produced at a scale of 1:200 000 (Appendix III). The grid references given are referable to both sets of maps.

The rock colours given in the lithology sections are determined by comparison with the 'Rock-colour chart' (1980) which is distributed by the Geological Society of America.

The macrofaunal identification and the interpretation of the age of the assemblages was carried out by Dr M. Romano and Dr. T.P. Young for the Ordovician field samples and by Dr. R.B. Rickards for the Silurian to Lower Devonian field samples.

For each sample, the lithostratigraphic position according to the relevant published geological map is given. Under the inferred lithostratigraphic subheading, the nomenclature used is that proposed by the Simon Robertson Group. This is the scheme that is adopted in the present study. A direct comparison between the two schemes is given in the figures in the introductory chapter.

1. THE ORDOVICIAN FIELD SAMPLES.

Sample: DJ 10
Location: Topographic map, Alnif. Geological map, Todrha Ma'der. Grid reference 5078 4886.
Lithology: Siltstone. Medium dark grey, angular break, micaceous.
Macrofauna observed: None.
Age derived from the macrofauna: None.
Lithostratigraphy according to the geological map: or5c, Upper Tiouririne Formation.
Inferred lithostratigraphic position: Ktaoua (sandstone and shale) Formation.

Sample: DJ 106

Location: Topographic map, Agdz. Geological map, Jbel Saghro-Dades. Grid reference 4185 4153.

Lithology: Shale-silty shale. Medium grey to medium dark grey, weathered to olive grey, angular break, nodular in part, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: The grid reference for this sample is located on drift deposits with or1-2, the Fezouata Shale, forming the adjacent outcrops.

Inferred lithostratigraphic position: Fezouata (shale) Formation.

Sample: DJ 107

Location: Topographic map, Agdz. Geological map, Jbel Saghro-Dades. Grid reference 4186 4155.

Lithology: Shale-silty shale. Medium grey to medium dark grey, weathered to olive grey, angular break, nodular in part, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map. The grid reference for this sample is located on drift deposits with 0r1-2, the Fezouata Shale, forming the adjacent outcrops.

Inferred lithostratigraphic position: Fezouata (shale) Formation.

Sample: DW 105

Location: Topographic map, Alnif. Geological map, Todrha Ma'der. Grid reference 5194 4703.

Lithology: Siltstone. Greenish grey to olive grey, angular break, faintly laminated, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: ks2 (Upper Cambrian shales).

Inferred lithostratigraphic position: ?

Sample: DW 115

Location: Topographic map, Alnif. Geological map, Todrha Ma'der. Grid reference 5061 4820.

Lithology: Siltstone. Greenish grey to olive grey, angular break, faintly laminated, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: ki3-4 (Lower Cambrian arenites).

Inferred lithostratigraphic position: ?

Sample: DW 261

Location: Topographic map, El Gloa. Geological map, Zagora Coude du Dra. Grid reference 4348 3740.

Lithology: Shale. Light olive grey weathered to dark yellowish orange, angular break, slightly micaceous.

Macrofauna observed: *Apatokephalus* cf. *incisus* Dean, cf. *Niobella* sp., ?*Salterocoryphe* sp., *Tarfaya marocana* Havlicek, inarticulate brachiopods indet., *Redonia* cf. *michelae* Babin, bivalve indet., bellerophontid indet., ostracods indet., *Planolites* or *Palaeophycus* ichnosp.

Age derived from the macrofauna: Upper Tremadoc to lower Arenig, probably lower Arenig.

Lithostratigraphy according to the geological map: The grid reference for this sample is located on drift deposits within the valley of Oued Bou Tious. Near-by, outcrops of or2, Fezouata Shales of Arenig age, are present on the valley floor.

Inferred lithostratigraphic position: Fezouata (shale) Formation.

Sample: DW 262

Location: Topographic map, El Gloa. Geological map, Zagora Coude du Dra. Grid reference 4348 3740.

Lithology: Shale. Light olive grey weathered to dark yellowish orange, subfissile, slightly micaceous.

Macrofauna observed: Proetid indet. (? gen. nov.), ?*Neseuretus* sp., *Tarfaya marocana* Havlicek, large inarticulate brachiopods indet., *Redonia* sp., cf. *Praeleda* sp., cf. *Cardiolaria* sp., ostracods indet., gastropods indet.

Age derived from the macrofauna: Arenig, probably lower Arenig.

Lithostratigraphy according to the geological map: The grid reference for this sample is located on drift deposits within the valley of Oued Bou Tious. Near-by, outcrops of or2, Fezouata Shales of Arenig age, are present on the valley floor.

Inferred lithostratigraphic position: Fezouata (shale) Formation.

Sample: DW 263

Location: Topographic map, El Gloa. Geological map, Zagora Coude du Dra. Grid reference 4348 3740.

Lithology: Shale. Light olive grey weathered to dark yellowish orange, subfissile, slightly micaceous.

Macrofauna observed: ?*Ogygiocaris* sp., *Neseuretus* or *Pradoella* sp., *Tarfaya marocana* Havlicek, cf. *Redonia* sp., ?*Expansograptus* sp., ostracods indet., orthocone nautoloid indet.

Age derived from the macrofauna: Arenig, probably lower Arenig.

Lithostratigraphy according to the geological map: The grid reference for this sample is located on drift deposits within the valley of Oued Bou Tious. Near-by, outcrops of or2, Fezouata Shales of Arenig age, are present on the valley floor.

Inferred lithostratigraphic position: Fezouata (shale) Formation.

Sample: DW 269

Location: Topographic map, El Gloa. Geological map, Zagora Coude du Dra. Grid reference 4297 3743.

Lithology: Shale. Light olive grey weathered to dark yellowish orange, angular break, slightly micaceous.

Macrofauna observed: ?niobellid indet., ?*Neseuretus* sp., ?*Redonia* sp., ?*Tetragraptus* sp., *Palaeophycus* ichnosp.

Age derived from the macrofauna: Probably Arenig.

Lithostratigraphy according to the geological map: The grid reference for this sample is located on drift deposits within the valley of Oued Bou Tious. Near-by, outcrops of or2, Fezouata Shales of Arenig age, are present on the valley floor.

Inferred lithostratigraphic position: Fezouata (shale) Formation.

Sample: DW 272

Location: Topographic map, El Gloa. Geological map, Zagora Coude du Dra. Grid reference 4297 3743.

Lithology: Shale. Light olive grey weathered to dark yellowish orange, angular break, micaceous, graptolites are common.

Macrofauna observed: ?*Asaphellus* sp., ?*Colpocoryphe* sp., ?*Clonograptus* sp.

Age derived from the macrofauna: Lower Arenig, just possibly Upper Tremadoc.

Lithostratigraphy according to the geological map: The grid reference for this sample is located on drift deposits within the valley of Oued Bou Tious. Near-by, outcrops of or2, Fezouata Shales of Arenig age, are present on the valley floor.

Inferred lithostratigraphic position: Fezouata (shale) Formation.

Sample: DW 291

Location: Topographic map, Agdz. Geological map, Jbel Saghro-Dades. Grid reference 3994 4103.

Lithology: Shale. Medium dark grey weathered to light olive grey, fissile, slightly micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: or1-2, Fezouata Shales.

Inferred lithostratigraphic position: Fezouata (shale) Formation.

Sample: DW 294

Location: Topographic map, Agdz. Geological map, Jbel Saghro-Dades. Grid reference 4186 4109.

Lithology: Silty shale. Medium dark grey weathered to light olive grey, angular break, slightly micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: or1-2, Fezouata Shales.

Inferred lithostratigraphic position: Fezouata (shale) Formation.

Sample: DW 303

Location: Topographic map, Agdz. Geological map, Zagora Coude du Dra. Grid reference 4317 3923.

Lithology: Silty shale. Medium grey , angular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: or1-2, Fezouata Shales. or1, the Lower Fezouata Shales and or2, the Upper Fezouata Shales are differenciated in the viscinity of sample DW 304 but the outcrops are poorly labelled.

Inferred lithostratigraphic position: Fezouata (shale) Formation.

Sample: DW 304

Location: Topographic map, Agdz. Geological map, Zagora Coude du Dra. Grid reference 4285 3965.

Lithology: Siltstone-silty shale. Medium light grey weathered to light olive grey, angular break, calcareous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: or1-2, Fezouata Shales. or1, the Lower Fezouata Shales and or2, the Upper Fezouata Shales are differenciated in the viscinity of sample DW 304 but the outcrops are poorly labelled.

Inferred lithostratigraphic position: Fezouata (shale) Formation.

Sample: DW 305

Location: Topographic map, Agdz. Geological map, Jbel Saghro-Dades. Grid reference 4280 4059.

Lithology: Siltstone-silty shale. Medium light grey weathered to light olive grey, angular break, calcareous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: or1-2, Fezouata Shales.

Inferred lithostratigraphic position: Fezouata (shale) Formation.

Sample: DW 307

Location: Topographic map, Agdz. Geological map, Jbel Saghro-Dades. Grid reference 4310 4151.

Lithology: Silty shale. Medium grey weathered to light olive grey, subfissile, nodular in part, slightly micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: or1-2, Fezouata Shales.

Inferred lithostratigraphic position: Fezouata (shale) Formation.

Sample: DW 309

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4465 4260.

Lithology: Shale. Greyish black, angular break, micaceous.

Macrofauna observed: cf. *Placoparia* (*P.*) *cambriensis* Hicks, kerfornellid indet., *Ormathops clariondi* Destombes, Calymenid indet., bivalve indet., hyolithid indet., ostracods indet., bellerophontid indet.

Age derived from the macrofauna: Arenig to Llanvirn, probably Llanvirn.
Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift which occurs between outcrops of or1-2, Fezouata Shales, and or3, Tachilla shales.
Inferred lithostratigraphic position: Tachillaa (shale) Formation, based on the presence of the Llanvirn aged macrofauna.

Sample: DW 310
Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4465 4260.
Lithology: Shale. Greyish black, angular break, micaceous.
Macrofauna observed: ?*Colpocoryphe* sp., *Ormathops* cf. *clariondi* Destombes, ?*Neseuretus* sp., cf. *Ectillaenus* sp., *Orthambonites*? sp., cf. *Leda* sp., hyolithid indet., ostracods indet. (three forms) *Planolites* ichnosp.
Age derived from the macrofauna: Probably Llanvirn.
Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift which occurs between outcrops of or1-2, Fezouata Shales, and or3, Tachilla shales.
Inferred lithostratigraphic position: Tachilla (shale) Formation, based on the presence of the Llanvirn aged macrofauna.

Sample: DW 323
Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4782 4237.
Lithology: Siltstone-silty shale. Medium dark grey, angular break, micaceous.
Macrofauna observed: *Colpocoryphe grandis* (Snajdr), ostracod indet. *Colpocoryphe grandis* is generally lower Caradoc in Western Europe, its only supposed Llandeilo occurrence being in Bohemia
Age derived from the macrofauna: Upper Llandeilo to lower Caradoc, probably Lower Caradoc.
Lithostratigraphy according to the geological map: The grid reference indicates the position of DW 323 on drift deposits which lie adjascent to outcrops of or4, the First Bani Sandstone and or5, the Ktaoua Clay & Sandstone.
Inferred lithostratigraphic position: The lithology and probable Lower Caradoc fauna suggests that this sample is assignable to the Ktaoua (Sandstone and Shale) Formation.

Sample: DW 332
Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4588 4033.
Lithology: Silty shale-siltstone. Medium dark grey weathered to light olive brown, angular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift which occurs adjacent to outcrops of or1-2, the Fezouata Shales.

Inferred lithostratigraphic position: Fezouata (shale) Formation.

Sample: DW 335

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4470 4092.

Lithology: Shale. Dark grey, angular break, slightly micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: 0r4, First Bani sandstone.

Inferred lithostratigraphic position: Probably the First Bani (sandstone) Formation. The lithology of dark grey shales makes this assignment questionable. The position of samples DW 335, DW 336 and DW 337 on the geological map indicates that DW 335 is older than DW 336, which is, in turn, older than DW 337.

Sample: DW 336

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4456 4097.

Lithology: Shale. Dark grey, angular break, micaceous, occasional shelly fragments present.

Macrofauna observed: ?*Deanaspis* sp., cf. *Onniella* sp., inarticulate brachiopods indet., *Praeleda* sp., *Glyptarca* sp., circular crinoid indet., gastropod indet.

Age derived from the macrofauna: Caradoc, probably lower Caradoc.

Lithostratigraphy according to the geological map: The grid reference for the sample is located on drift deposits which lie between outcrops of or4, the First Bani Sandstone and or6a, the Upper Ktaoua.

Inferred lithostratigraphic position: The lithology, the position on the geological map and the fauna present indicate that this sample is from the Ktaoua (sandstone and shale) Formation. The position of samples DW 335, DW 336 and DW 337 on the geological map indicates that DW 335 is older than DW 336, which is, in turn, older than DW 337.

Sample: DW 337

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4419 4107.

Lithology: Shale. Dark grey, angular break, micaceous, shelly fragments are common.

Macrofauna observed: ?*Deanaspis* sp., cf. *Glyptarca* sp., circular crinoid indet., gastropod indet.

Age derived from the macrofauna: Probably Caradoc.

Lithostratigraphy according to the geological map: The grid reference for the sample is located on drift deposits which lie between outcrops of or4, the First Bani Sandstone and or6a, the Upper Ktaoua.

Inferred lithostratigraphic position: The lithology, the position on the geological map and the fauna present indicate that this sample is from the Ktaoua (sandstone and shale) Formation. The position of samples DW 335, DW 336 and DW 337 on the geological map indicates that DW 335 is older than DW 336, which is, in turn, older than DW 337.

Sample: DW 348

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4617 4285.

Lithology: Ironstone. Brownish grey mottled with greyish red purple, weathered to light brownish grey, silt-fine sand grade grain size, angular break, common black specs of iron mineral, micaceous, redened bioclastic fragments present.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: or1-2, Fezouata Shales.

Inferred lithostratigraphic position: Fezouata (shale) Formation. However, there is no indication on the map of ironstone lithologies at the outcrop from which the sample was taken.

Sample: DW 349

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4654 4212.

Lithology: Siltstone-silty shale. Medium dark grey, angular break, micaceous.

Macrofauna observed: *Colpocoryphe grandis* (Snajdr). *Colpocoryphe grandis* is generally lower Caradoc in Western Europe, its only supposed Llandeilo occurrence being in Bohemia.

Age derived from the macrofauna: Upper Llandeilo to lower Caradoc, probably Lower Caradoc.

Lithostratigraphy according to the geological map: or5a, Lower Ktaoua.

Inferred lithostratigraphic position: Ktaoua (sandstone and shale) Formation.

Sample: DW 350

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4651 4208.

Lithology: Siltstone-silty shale. Medium dark grey, angular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: or5a, Lower Ktaoua.

Inferred lithostratigraphic position: Ktaoua (sandstone and shale) Formation.

Sample: DW 351

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4651 4198.

Lithology: Shale-silty shale. Dark grey weathered to olive grey, angular greak, slightly nodular, slightly micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: or5a, Lower Ktaoua.

Inferred lithostratigraphic position: Ktaoua (sandstone and shale) Formation.

Sample: DW 352

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4650 4199.

Lithology: Siltstone-silty sandstone. Dark grey, angular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: or5a, Lower Ktaoua.

Inferred lithostratigraphic position: Ktaoua (sandstone and shale) Formation.

Sample: DW 353

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4683 4208.

Lithology: Siltstone-silty shale. Medium dark grey, angular break, micaceous, shelly material is common.

Macrofauna observed: *Colpocoryphe grandis* (Snajdr), *Triplesia* sp., *Aegiromena aquila praecursor* (Havlicek), cf. *Drabovia* sp., crinoid indet.

Age derived from the macrofauna: Lower Caradoc.

Lithostratigraphy according to the geological map: or4, First Bani Sandstone.

Inferred lithostratigraphic position: The position of the sample on the geological map indicates that it is taken from the youngest margin of a First Bani (sandstone) Formation outcrop.

Sample: DW 354

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4683 4208.

Lithology: Siltstone-silty shale. Medium dark grey, angular break, micaceous, occasional shelly fragments present.

Macrofauna observed: *Colpocoryphe grandis* (Snajdr), Onniella sp., *Aegiromena aquila praecursor* (Havlicek), cystoid indet., crinoid indet., gastropod.

Age derived from the macrofauna: Lower Caradoc.

Lithostratigraphy according to the geological map: or4, First Bani Sandstone.

Inferred lithostratigraphic position: The position of the sample on the geological map indicates that it is taken from the youngest margin of a First Bani (sandstone) Formation outcrop.

Sample: DW 359

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4653 4133.

Lithology: Shale-silty shale. Medium dark grey, angular break, nodular in part, slightly micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: or6a, Upper Ktaoua.

Inferred lithostratigraphic position: Ktaoua (sandstone and shale) Formation.

Sample: DW 360

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4694 4115.

Lithology: Shale-silty shale. Medium dark grey, subfissile, nodular in part, slightly micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: The grid reference for this sample is postioned on drift deposits between outcrops of or4, the First Bani Sandstone and or6a, the Upper Ktaoua.

Inferred lithostratigraphic position: Probably the Ktaoua (sandstone and shale) Formation.

Sample: DW 361

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4707 4111.

Lithology: Shale. Dark grey, angular break, nodular in part, micaceous.

Macrofauna observed: Dalminitid indet., inarticulate brachiopods indet., dalmanellid indet., cf. *Praeleda* sp., hyolithid indet., pentamerid crinoid.

Age derived from the macrofauna: Llandeillo to Caradoc.

Lithostratigraphy according to the geological map: or6a, Upper Ktaoua. The macrofauna present in this sample indicates that the age assigned to this unit on the map is incorrect.

Inferred lithostratigraphic position: Ktaoua (sandstone and shale) Formation.

Sample: DW 362

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4707 4111.

Lithology: Silty shale. Dark grey, angular break, nodular in part, micaceous.

Macrofauna observed: *Flexicalymene* sp., *Colpocoryphe grandis* (Snajdr), cf. *Drabovia* sp., gastropod indet., crinoid indet.

Age derived from the macrofauna: Llandeillo to lower Caradoc, probably lower Caradoc.

Lithostratigraphy according to the geological map: or6a, Upper Ktaoua. The macrofauna present in this sample indicates that the age assigned to this unit on the map is incorrect.

Inferred lithostratigraphic position: Ktaoua (sandstone and shale) Formation.

Sample: DW 364

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4775 4095.

Lithology: Silty shale. Dark grey, angular break, nodular in part, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits adjacent to outcrops of or5a, Lower Ktaoua.

Inferred lithostratigraphic position: Ktaoua (sandstone and shale) Formation.

Sample: DW 415

Location: Topographic map, Tarhbalt. Geological map, Todrha Ma'der. Grid reference 5143 4260.

Lithology: Silty shale. Dark grey weathered to medium light grey or light brownish grey, fissile to subfissile, nudular in part, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits located some distance (ca. 2 km) from outcrops of or4, the First Bani Sandstone and or5, the Lower Ktaoua and the Upper Tiouririne Formation.
Inferred lithostratigraphic position: Ktaoua (sandstone and shale) Formation.

Sample: GAO 65
Location: Topographic map, Alnif. Geological map, Todrha Ma'der. Grid reference 5132 4694.
Lithology: Siltstone. Greenish grey to olive grey, angular break, micaceous.
Macrofauna observed: None.
Age derived from the macrofauna: None.
Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits located between outcrops of ks2 (Upper Cambrian shales) and or2, Upper Fezouata Shales.
Inferred lithostratigraphic position: Probably the Fezouata (shale) Formation.

Sample: GAO 67
Location: Topographic map, Alnif. Geological map, Todrha Ma'der. Grid reference 5135 4693.
Lithology: Shale. Black, friable, very carbonaceous.
Macrofauna observed: None.
Age derived from the macrofauna: None.
Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits located between outcrops of ks2 (Upper Cambrian shales) and or2, Upper Fezouata Shales.
Inferred lithostratigraphic position: Probably the Fezouata (shale) Formation.

Sample: GAO 388
Location: Topographic map, Foum Zguit. Geological map, Ouarzazate Alougoum. Grid reference 3571 3459.
Lithology: Silty sandstone. Yellowish grey, heavily weathered to light brown or greyish orange pink, fine grained and silty in part, moderately well cemented, angular break, abundant shelly bioclasts present.
Macrofauna observed: ?*Kerfornella* sp., inarticulate brachiopods indet., bryozoans indet., gastropod indet., bellerophontid indet.
Age derived from the macrofauna: Llanvirn to Llandeilo
Lithostratigraphy according to the geological map: or6b, Second Bani Sandstone

Inferred lithostratigraphic position: The Llanvirn to Llandeilo age of the macrofossils recorded from this sample suggest that it was taken from the First Bani Sandstone rather than the Second Bani Sandstone, the latter is typically upper Ashgill in age.

Sample: GAO 471

Location: Topographic map, Tleta de Tagmoute. Geological map, Akka Tafagount Tata. Grid reference 2401 3025.

Lithology: Sandstone. Light olive grey, fine grained, well cemented, angular break, micaceous.

Macrofauna observed: *Tissintia convergens* Havlicek

Age derived from the macrofauna: Llandeilo.

Lithostratigraphy according to the geological map: The grid reference for this sample is postioned on drift deposits adjacent to outcrops of or4, the First Bani Sandstone.

Inferred lithostratigraphic position: First Bani (sandstone) Formation.

Sample: JD 29

Location: Topographic map, Alnif. Geological map, Todrha Ma'der. Grid reference 5160 4640.

Lithology: Shale-silty shale. Medium dark grey weathered to olive grey, subfissile, laminated, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits adjacent to outcrops of or1-2, the Fezouata Shales.

Inferred lithostratigraphic position: Fezouata (shale) Formation.

Sample: JHO 220

Location: Topographic map, Fask. Geological map, Goulimine et du Dra Inferieur. Grid reference 0980 2107.

Lithology: Sandstone. Dark yellowish orange weathered to moderate brown, fine grained, moderately well cemented, micaceous, abundant shelly fauna.

Macrofauna observed: ?*Neseuretus* sp., *Paterorthis* cf. *paterina* Havlicek.

Age derived from the macrofauna: Llandeilo.

Lithostratigraphy according to the geological map: si1, Llandeilo sandstones.

Inferred lithostratigraphic position: First Bani (sandstone) Formation.

Sample: JW 4

Location: Topographic map, Agdz. Geological map, Jbel Saghro-Dades. Grid reference 4345 4162.

Lithology: Shale. Medium dark grey, irregular break, slightly micaceous, abundant poorly preserved fauna.

Macrofauna observed: ?indet. trilobite fragments, ?*Tarfaya* sp., bivalves indet., gastropod indet.

Age derived from the macrofauna: If the identification of *Tarfaya* sp. is correct then Arenig.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits adjacent to outcrops of or1-2, the Fezouata Shales.

Inferred lithostratigraphic position: Fezouata (shale) Formation. It appears from the relative positions of samples JW 4 and JW 5 on the geological map that JW 4 is probably the older of the two.

Sample: JW 5

Location: Topographic map, Agdz. Geological map, Jbel Saghro-Dades. Grid reference 4370 4168.

Lithology: Shale. Medium dark grey, irregular break, slightly micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits adjacent to outcrops of or1-2, the Fezouata Shales.

Inferred lithostratigraphic position: Fezouata (shale) Formation. It appears from the relative positions of samples JW 4 and JW 5 on the geological map that JW 4 is probably the older of the two.

Sample: TD 17

Location: Topographic map, Hassi Bou al M'Amra. Geological map, Goulimine et du Dra Inferieur. Grid reference 0161 1622.

Lithology: Shale. Light olive brown weathered to yellowish grey, subfissile, few graptolites present.

Macrofauna observed: *Climacograptus normalis* Lapworth, *Climacograptus angustus* Perner, *Climacograptus* sp., *Orthograptus* sp., *Diplograptus modestus* Lapworth, *Diplograptus* sp., *Glyptograptus* gr. *persculptus* (Salter), *Glyptograptus* sp.

Age derived from the macrofauna: Ordovician, Upper Ashgill, probably *persculptus* Zone (?upper part).

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits adjacent to outcrops of ss (Gothlandien, ie Silurian) and si4, the Bani Sandstone.

Inferred lithostratigraphic position: Second Bani (sandstone) Formation., based on the lithology and the macrofaunal content.

2. THE SILURIAN-LOWER DEVONIAN FIELD SAMPLES

Sample: DJ 84

Location: Topographic map, Boumalne. Geological map, Jbel Saghro-Dades. Grid reference 4841 0952.

Lithology: Shale. Medium light grey weathered to light brown, subfissle.

Macrofauna observed: *Pristiograptus dubius* (Suess), *Cyrtograptus* cf. *ellesae* Gortani, *Monograptus flemingii* (Salter).

Age derived from the macrofauna: Middle Wenlock, upper Sheinwoodian, probably *ellesae* Zone.

Lithostratigraphy according to the geological map: or5a, Lower Ktaoua.

Inferred lithostratigraphic position: Argillaceous Shale Formation. This is based on the lithology and on the age of the macrofaunal content. There are Silurian aged rocks evident in the viscinity of the grid reference for this sample which suggests that the lithostratigraphic position according to the geological map may be an error in mapping or in the grid reference taken for the sample.

Sample: DW 34

Location: Topographic map, Msissi. Geological map, Todrha Ma'der. Grid reference 5431 4640.

Lithology: Shale. Greyish black, irregular break, slightly micaceous, abundant graptolites present.

Macrofauna observed: *Bohemograptus bohemicus* (Barrande), *Lobograptus scanicus* Tullberg, *Saetograptus chimaera* (Barrande).

Age derived from the macrofauna: Lower Ludlow, Gorstian, *scanicus* Zone.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits adjacent to outcrops of Ordovician, Silurian and Devonian rocks.

Inferred lithostratigraphic position: Argillaceous Shale Formation. This is based on the lithology (note that the Argillaceous Shale Formation is more organically rich [darker in colour] and graptolite rich in the Tazzarine area, as stated in the 'lithostratigraphic framework' section of this study) and on the age of the faunal content.

Sample: DW 51

Location: Topographic map, Msissi. Geological map, Todrha Ma'der. Grid reference 5410 4663.

Lithology: Shale. Greyish black, irregular break, slightly micaceous, occasional graptolites present.

Macrofauna observed: *Monograptus prognatus* Koren' or *M. pridoliensis* Pribyl, ?*Monograptus beatus* Koren', *Linograptus posthumus* Richter, *Pristograptus dubius* (Suess), *Monograptus* cf. *subhercynicus* Willerfert

Age derived from the macrofauna: Pridoli

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits adjacent to outcrops of di1-3 (Lower Devonian).

Inferred lithostratigraphic position: Calcareous Shale Formation, Black Shale Member. The age of this sample, derived from the macrofauna present, Pridoli, suggests that deposition of the Black Shale Member of the Calcareous Shale Formation was initiated prior to the Lochkovian. Lochkovian was the age previously assigned to this member.

Sample: DW 52

Location: Topographic map, Msissi. Geological map, Todrha Ma'der. Grid reference 5410 4663.

Lithology: Shale. Dark grey, subfissile, micaceous, abundant graptolites present.

Macrofauna observed: *Linograptus posthumus* Richter, *Monograptus* aff. *pridoliensis* Pribyl, *Monograptus* aff. *mironovi* Koren', *Monograptus* aff. *beatus* Koren'.

Age derived from the macrofauna: Pridoli, approximating to the *lochkoviensis* Zone.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits adjacent to outcrops of di1-3 (Lower Devonian).

Inferred lithostratigraphic position: Calcareous Shale Formation, Black Shale Member. The age of this sample, derived from the macrofauna present, Pridoli, suggests that deposition of the Black Shale Member of the Calcareous Shale Formation was initiated prior to the Lochkovian. Lochkovian was the age previously assigned to this member.

Sample: DW 55

Location: Topographic map, Msissi. Geological map, Todrha Ma'der. Grid reference 5410 4663.

Lithology: Shale. Dark grey, subfissile, slightly micaceous, abundant graptolites present.

Macrofauna observed: *Monograptus* cf. *subhercynicus* Willefert, *Linograptus posthumus* Richter, *Monograptus* aff. *pridoliensis* Pribyl, *Monograptus* sp., cf. *Abeisgraptus* sp.

Age derived from the macrofauna: Pridoli, *lochkoviensis* Zone.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits adjacent to outcrops of di1-3 (Lower Devonian).

Inferred lithostratigraphic position: Calcareous Shale Formation, Black Shale Member. The age of this sample, derived from the macrofauna present, Pridoli, suggests that deposition of the Black Shale Member of the Calcareous Shale Formation was initiated prior to the Lochkovian. Lochkovian was the age previously assigned to this member.

Sample: DW 56

Location: Topographic map, Msissi. Geological map, Todrha Ma'der. Grid reference 5410 4663.

Lithology: Shale. Dark grey, subfissile, slightly micaceous, graptolites are common.

Macrofauna observed: *Monograptus* cf. *pridoliensis* Pribyl, *Linograptus posthumus* Richter.

Age derived from the macrofauna: Pridoli, *lochkoviensis* Zone.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits adjacent to outcrops of di1-3 (Lower Devonian).

Inferred lithostratigraphic position: Calcareous Shale Formation, Black Shale Member. The age of this sample, derived from the macrofauna present, Pridoli, suggests that deposition of the Black Shale Member of the Calcareous Shale Formation was initiated prior to the Lochkovian. Lochkovian was the age previously assigned to this member.

Sample: DW 57

Location: Topographic map, Msissi. Geological map, Todrha Ma'der. Grid reference 5410 4663.

Lithology: Shale. Dark grey, subfissile, slightly micaceous, few graptolites present.

Macrofauna observed: *Monograptus* aff. *uniformis* Pribyl.

Age derived from the macrofauna: Lochkovian, *uniformis* Zone.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits adjacent to outcrops of di1-3 (Lower Devonian).

Inferred lithostratigraphic position: Calcareous Shale Formation, Black Shale Member.

Sample: DW 58

Location: Topographic map, Msissi. Geological map, Todrha Ma'der. Grid reference 5410 4663.

Lithology: Shale. Greyish black, irregular break, slightly micaceous.

Macrofauna observed: *Monograptus* aff. *uniformis* Pribyl, *Monograptus* cf. *pridoliensis* Pribyl

Age derived from the macrofauna: Lochkovian, *uniformis* Zone.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits adjacent to outcrops of di1-3 (Lower Devonian).

Inferred lithostratigraphic position: Calcareous Shale Formation, Black Shale Member.

Sample: DW 94

Location: Topographic map, Msissi. Geological map, Todrha Ma'der. Grid reference 5410 4572.

Lithology: Shale. Greyish black, irregular break, slightly micaceous.

Macrofauna observed: *Monograptus transgrediens* Perner

Age derived from the macrofauna: Pridoli, *transgrediens* Zone

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits adjacent to an outcrop of s4 (Pridoli).

Inferred lithostratigraphic position: Calcareous Shale Formation, Black Shale Member. The age of this sample, derived from the macrofauna present, Pridoli, suggests that deposition of the Black Shale Member of the Calcareous Shale Formation was initiated prior to the Lochkovian. Lochkovian was the age previously assigned to this member.

Sample: DW 96

Location: Topographic map, Alnif. Geological map, Todrha Ma'der. Grid reference 5390 4605.

Lithology: Shale. Dark grey, subfissile, slightly micaceous.

Macrofauna observed: *Monograptus yukonensis* Jackson & Lenz.

Age derived from the macrofauna: Pragian (Siegenian), *yukonensis* Zone

Lithostratigraphy according to the geological map: S4 (Pridoli).

Inferred lithostratigraphic position: The macofauna recorded here is clearly younger than the age assigned to the outcrop from which the sample was taken on the geological map. This dark grey shale of Pragian age is probably assignable to either the Lmhaifid Formation or the Assa Formation.

Sample: DW 97

Location: Topographic map, Alnif. Geological map, Todrha Ma'der. Grid reference 5390 4605.

Lithology: Shale. Dark grey, subfissile, slightly micaceous.

Macrofauna observed: *Monograptus* cf. *aequabilis*, *Monograptus notaequabilis* Jackson & Stein, *Monograptus yukonensis* Jackson & Lenz subsp.

Age derived from the macrofauna: Pragian (Siegenian), *yukonensis* Zone

Lithostratigraphy according to the geological map: S4 (Pridoli).

Inferred lithostratigraphic position: The macrofauna recorded here is clearly younger than the age assigned to the outcrop from which the sample was taken on the geological map. This dark grey shale of Pragian age is probably assignable to either the Lmhaifid Formation or the Assa Formation.

Sample: DW 162

Location: Topographic map, Msissi. Geological map, Todrha Ma'der. Grid reference 5502 4699.

Lithology: Shale. Black, fissile, very carbonaceous, slightly micaceous.

Macrofauna observed: *Monograptus priodon* (Bronn), *Monograptus riccartonensis* Lapworth, ?*Pristiograptus dubius* (Suess).

Age derived from the macrofauna: Middle Wenlock, upper Sheinwoodian, *riccartonensis* Zone.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits adjacent to an outcrop of or6, the Second Bani Sandstone.

Inferred lithostratigraphic position: Carbonaceous Shale Formation. This is based on the lithology and on the age of the macrofauna present. In the viscinity of the sampled outcrop, s2 sediments on the

map (Llandovery to Wenlock in age) commonly outcrop in association with the or6 unit. This suggests there has been an error in the mapping or an error in the grid reference taken for the sample.

Sample: DW 164

Location: Topographic map, Msissi. Geological map, Todrha Ma'der. Grid reference 5502 4699.

Lithology: Shale. Greyish black, fissile, carbonaceous, slightly micaceous.

Macrofauna observed: *Retiolites geinitzianus*, *Retiolites densireticulatus* (Boucek), *Monograptus priodon* (Bronn) s.l., *Pristiograptus nudus* (Lapworth), *Monoclimacis* cf. *crenulata* sensu Elles & Wood, *Monograptus* sp.

Age derived from the macrofauna: Uppermost Llandovery, upper Telychian, *crenulata* Zone

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits adjacent to an outcrop of or6, the Second Bani Sandstone.

Inferred lithostratigraphic position: Carbonaceous Shale Formation. This is based on the lithology and on the age of the macrofauna present. In the viscinity of the sampled outcrop, s2 sediments on the map (Llandovery to Wenlock in age) commonly outcrop in association with the Second Bani Sandstone. This suggests there has been an error in the mapping or an error in the grid reference taken for the sample.

Sample: DW 215

Location: Topographic map, Erfoud. Geological map, Tafilalt Taouz. Grid reference 6148 0578.

Lithology: Limestone. Medium grey, very hard, common orthoconic bioclasts, sparitic matrix, packstone texture. Bio sparitic packstone.

Macrofauna observed: *Saetograptus* cf. *incipiens* (Wood), *Saetograptus chimaera* (Barrande).

Age derived from the macrofauna: 'Middle' Ludlow.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits located between outcrops of di, Lower Devonian, and dm, Middle Devonian, sediments. The lithology clearly indicates that this sample is from the *Orthoceras* limestone Formation which is shown on the map to outcrop in the viscinity of the position of the grid reference for this sample.

Inferred lithostratigraphic position: *Orthoceras* Limestone-Shale Formation.

Sample: DW 230

Location: Topographic map, Mdaouer. Geological map, Agadir Tissinnt Oued Zemoul. Grid reference 3777 3231.

Lithology: Shale. Light grey with pale red purple laminae, fissile, soapy texture.

Macrofauna observed: *Monograptus ludensis* (Murchison), ?*Pristiograptus dubius* (Suess)

Age derived from the macrofauna: Upper Wenlock, Homerian, *ludensis* Zone.

Lithostratigraphy according to the geological map: s2, lower Ludlow argillaceous shales.

Inferred lithostratigraphic position: Argillaceous Shale Formation.

Sample: DW 231

Location: Topographic map, Mdaouer. Geological map, Agadir Tissinnt Oued Zemoul. Grid reference 3777 3231.

Lithology: Shale. Light grey weathered to light brownish grey, fissile, soapy texture.

Macrofauna observed: *Monograptus ludensis* (Murchison), *Pristiograptus dubius* (Suess), *Pristiograptus jaegeri* Holland *et al.*

Age derived from the macrofauna: Upper Wenlock, Homerian, *ludensis* Zone.

Lithostratigraphy according to the geological map: s2, lower Ludlow argillaceous shales.

Inferred lithostratigraphic position: Argillaceous Shale Formation.

Sample: DW 232

Location: Topographic map, Mdaouer. Geological map, Agadir Tissinnt Oued Zemoul. Grid reference 3777 3231.

Lithology: Shale. Medium dark grey, fissile, slightly micaceous.

Macrofauna observed: *Colonograptus* sp.

Age derived from the macrofauna: Ludlow.

Lithostratigraphy according to the geological map: s2, lower Ludlow argillaceous shales.

Inferred lithostratigraphic position: Argillaceous Shale Formation. From the relative positions of samples DW 232, DW 234 and DW 235 on the geological map, it appears that DW 232 is older than DW 234 and DW 235.

Sample: DW 234

Location: Topographic map, Mdaouer. Geological map, Agadir Tissinnt Oued Zemoul. Grid reference 3777 3225.

Lithology: Shale. Light grey weathered to light brownish grey, fissile, soapy texture.

Macrofauna observed: *Saetograptus fritschi* cf. *linearis* (Boucek) *Saetograptus varians*, *Pristiograptus dubius* (Suess).

Age derived from the macrofauna: Ludlow.

Lithostratigraphy according to the geological map: s2, lower Ludlow argillaceous shales.

Inferred lithostratigraphic position: Argillaceous Shale Formation. From the relative positions of samples DW 232, DW 234 and DW 235 on the geological map, it appears that DW 232 is older than DW 234 and DW 235.

Sample: DW 235

Location: Topographic map, Mdaouer. Geological map, Agadir Tissinnt Oued Zemoul. Grid reference 3777 3225.

Lithology: Shale. Medium dark grey weathered to light brown, subfissile, slightly micaceous.

Macrofauna observed: cf. *Saetograptus fritschi* cf. *linearis* (Boucek).

Age derived from the macrofauna: Ludlow.

Lithostratigraphy according to the geological map: s2, lower Ludlow argillaceous shales.

Inferred lithostratigraphic position: Argillaceous Shale Formation. From the relative positions of samples DW 232, DW 234 and DW 235 on the geological map, it appears that DW 232 is older than DW 234 and DW 235.

Sample: DW 246

Location: Topographic map, Zaouia. Geological map, Zagora Coude du Dra. Grid reference 3999 3302.

Lithology: Shale. Dark grey with pale olive weathered surface, fissile, micaceous.

Macrofauna observed: ?*Monograptus griestoniensis* (Nicol), *Monograptus exiguus* (Nicholson), ?*Monograptus spiralis* (Geinte), ?*Monograptus proteus* (Barrande), ?*Monograptus turriculatus* (Barrande), ?*Monoclimacis galaensis* (Lapworth).

Age derived from the macrofauna: Llandovery, lower Telychian, ?*turriculatus*-?*crispus* Zones.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits which lie adjacent to outcrops of s1, the Ain Chebi Formation.

Inferred lithostratigraphic position: Carbonaceous Shale Formation.

Sample: DW 248

Location: Topographic map, Zaouia. Geological map, Zagora Coude du Dra. Grid reference 4008 3311.

Lithology: Shale. Black, fissile, carbonaceous and micaceous, graptolites are common.

Macrofauna observed: *Monograptus spiralis* Geinitz, *Monograptus priodon* (Bronn), *Monograptus parapriodon* Boucek, *Pristiograptus nudus* Lapworth, *Monoclimacis* sp., *Monoclimacis crenulata* sensu Elles & Wood, *Monoclimacis griestoniensis* (Nicol) s.l.

Age derived from the macrofauna: Llandovery, Telychian, *griestoniensis* Zone.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits which lie adjacent to outcrops of s1, the Ain Chebi Formation.

Inferred lithostratigraphic position: Carbonaceous Shale Formation.

Sample: DW 249

Location: Topographic map, Zaouia. Geological map, Zagora Coude du Dra. Grid reference 4008 3311.

Lithology: Shale. Black, subfissile, carbonaceous and slightly micaceous.

Macrofauna observed: *Pristiograptus nudus* (Lapworth), *Monograptus priodon* (Bronn), *Monoclimacis* sp., *Monoclimacis crenulata* sensu Elles & Wood, *Monograptus* cf. *parapriodon* Boucek, ?*Monograptus tullbegi*, ?*Monograptus wimani*, *Monovlimacis griestoniensis* (Nicol) s.l.

Age derived from the macrofauna: Llandovery, upper Telychian, *crenulata* Zone.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits which lie adjacent to outcrops of s1, the Ain Chebi Formation.

Inferred lithostratigraphic position: Carbonaceous Shale Formation.

Sample: DW 250

Location: Topographic map, Zaouia. Geological map, Zagora Coude du Dra. Grid reference 4008 3311.

Lithology: Shale. Greyish black, subfissile, micaceous.

Macrofauna observed: *Monograptus spiralis* Geinitz *Monograptus priodon* (Bronn), *Monoclimacis crenulata* sensu Elles & Wood, *Pristiograptus nudus* (Lapworth), *Monograptus rickardsi* Hutt, '*Streptograptus*' sp.

Age derived from the macrofauna: Llandovery, upper Telychian, *crenulata* Zone.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits which lie adjacent to outcrops of s1, the Ain Chebi Formation.

Inferred lithostratigraphic position: Carbonaceous Shale Formation.

Sample: DW 251

Location: Topographic map, Zaouia. Geological map, Zagora Coude du Dra. Grid reference 4008 3311.

Lithology: Greyish black and dark grey laminated shale with intercalated dark grey silty shale. The laminated shale is subfissile, carbonaceous and micaceous with abundant graptolites. The dark grey silty shale more massive and micaceous.

Macrofauna observed: *Retiolites geinitzianus* cf. *densireticulatus* Boucek, *Monograptus rickardsi* Hutt s.l., *?Monograptus priodon* (Bronn), *Monograptus spiralis* Geinitz.

Age derived from the macrofauna: Llandovery, upper Telychian, probably *crenulata* Zone.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits which lie adjacent to outcrops of s1, the Ain Chebi Formation.

Inferred lithostratigraphic position: Carbonaceous Shale Formation.

Sample: DW 355

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4655 4165.

Lithology: Black, subfissile, slightly micaceous, carbonaceous, abundant graptolites present.

Macrofauna observed: *Monograptus* ex. gr. *flemingii* (Salter), *Pristiograptus dubius* (Suess), *Pristiograptus* sp., *Cyrtograptus* sp., *Pristiograptus meneghini/Pristiograptus pseudodubius* (probably a transitional form between the two species).

Age derived from the macrofauna: 'Middle' Wenlock, upper Sheinwoodian, *?flexilis* Zone.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits positioned between outcrops of or6, the Second Bani Sandstone and s1-3 (Silurian).

Inferred lithostratigraphic position: Carbonaceous Shale Formation or Argillaceous Shale Formation.

Sample: DW 356

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4655 4165.

Lithology: Shale. Black, subfissile, slightly micaceous, carbonaceous, abundant graptolites present.

Macrofauna observed: *Cytograptus ?rigidus cautleyensis* Rickards, *Monograptus flemingii* (Salter), *Monoclimacis* cf. *kingii* Rickards, *Monoclimacis flumendosae* (Gortani), *Pristiograptus dubius* (Suess), *Pristiograptus* sp., *Monograptus flemingii* (Salter) s.l.

Age derived from the macrofauna: 'Middle' Wenlock, upper Sheinwoodian, probably *flexilis* Zone.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits positioned between outcrops of or6, the Second Bani Sandstone and s1-3 (Silurian).

Inferred lithostratigraphic position: Carbonaceous Shale Formation or Argillaceous Shale Formation.

Sample: DW 357

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4655 4172.

Lithology: Shale. Black, irregular break, slightly micaceous, carbonaceous.

Macrofauna observed: *Monograptus* cf. *riccartonensis*.

Age derived from the macrofauna: 'Middle' Wenlock, upper Sheinwoodian, *riccartonensis* Zone.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits positioned between outcrops of or6, the Second Bani Sandstone and s1-3 (Silurian).

Inferred lithostratigraphic position: Carbonaceous Shale Formation or Argillaceous Shale Formation.

Sample: DW 358

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4662 4169.

Lithology: Shale. Black, irregular break, slightly micaceous, abundant graptolites present.

Macrofauna observed: *Pristiograptus dubius* (Suess), *Pristiograptus* sp., *Monoclimacis flumendosae* (Gortani), *Pristiograptus*? *meneghini* (Gortani).

Age derived from the macrofauna: 'Middle' Wenlock, ?Sheinwoodian.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits positioned between outcrops of or6, the Second Bani Sandstone and s1-3 (Silurian).

Inferred lithostratigraphic position: Carbonaceous Shale Formation or Argillaceous Shale Formation.

Sample: DW 367

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4845 4203.

Lithology: Black, subfissile, slightly micaceous, carbonaceous, graptolites are common.

Macrofauna observed: *Pristiograptus dubius* (Suess), *Monoclimacis flemingii/flumendosae* (Gortani), *Monograptus flemingii/priodon*, *Climacograptus cantheyensis*, *Pristiograptus meneghini* (Gortani).

Age derived from the macrofauna: Wenlock, upper Sheinwoodian, *riccartonensis/rigidus* zonal boundary..

Lithostratigraphy according to the geological map: s1-3 (Silurian).

Inferred lithostratigraphic position: Carbonaceous Shale Formation.

Sample: JW 9

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4848 4112.

Lithology: Shale. Light grey weathered to light brownish grey, fissile, soapy texture.

Macrofauna observed: *Monograptus flemingii* (Salter), *Pristiograptus pseudodubius* (Boucek), *Cytograptus* cf. *ellesae* Gortani, *Monoclimacis flumendosae* (Gortani), *Pristiograptus jaegeri*.

Age derived from the macrofauna: Wenlock, upper Sheinwoodian, probably *ellesae* Zone.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits positioned adjacent to outcrops of s1-3 (Silurian).

Inferred lithostratigraphic position: Argillaceous Shale Formation.

Sample: JW 10

Location: Topographic map, Tazzarine. Geological map, Jbel Saghro-Dades. Grid reference 4885 4200.

Lithology: Shale. Dark grey, subfissile, slightly micaceous.

Macrofauna observed: *Lobograptus scanicus* Tullberg s.l., *Saetograptus chimaera* (Barrande) s.l., *Saetograptus* sp.

Age derived from the macrofauna: Ludlow, Ludfordian, approximately *tumescens* (*incipiens*) Zone or higher.

Lithostratigraphy according to the geological map: s2 (Telychian-Sheinwoodian-Homerian aged shales).

Inferred lithostratigraphic position: Argillaceous Shale Formation. The date given for the outcrop from which this sample was taken on the geological map appears to be incorrect from the macrofaunal evidence here.

Sample: JW 46

Location: Topographic map, Tata. Geological map, Akka Tafagount Tata. Grid reference 2778 3023.

Lithology: Shale. Medium dark grey, fissile, slightly micaceous.

Macrofauna observed: *Monograptus discus* Barrande, *Retiolites geinitzianus* (Barrande) s.l., *Monograptus planus* (Barrande).

Age derived from the macrofauna: Upper Llandovery, Telychian, could be either *crispus* or *griestoniensis* Zone on this association.

Lithostratigraphy according to the geological map: s1 (Llandovery-Wenlock aged shales).

Inferred lithostratigraphic position: Carbonaceous Shale Formation.

Sample: JW 224

Location: Topographic map, Alnif. Geological map, Todrha Ma'der. Grid reference 5021 4959.

Lithology: Shale. Dark grey, subfissile, slightly micaceous.

Macrofauna observed: *Bohemagraptus bohemicus* (Barrande), *Colonograptus colonus* (Barrande), *Monograptus uncinatus* Tullberg.

Age derived from the macrofauna: Ludlow, Gorstian, upper *nilssoni* zone.

Lithostratigraphy according to the geological map: The grid reference for this sample is positioned on drift deposits. The outcrops indicated on the map in the close viscinity of the grid reference are of Devonian and Carboniferous age. However, there are Ludlow aged outcrops approximately 6km to the south-east along strike.

Inferred lithostratigraphic position: Carbonaceous Shale Formation, based on the lithology and the macrofauna present.

Sample: JW 249

Location: Topographic map, Fask. Geological map, Goulimine et du Dra Inferieur. Grid reference 0920 2215.

Lithology: Shale. Medium dark grey, fissile, micaceous.

Macrofauna observed: *Monograptus turriculatus* (Barrande), *Monograptus runcinatus* Lapworth, *Pseudoplegmatograptus obesus* (Lapworth), *Monograptus marri* (Perner), *Monograptus proteus* (Barrande), *Monograptus gemmatus* sensu Elles & Wood.

Age derived from the macrofauna: Llandovery, lower Telychian, *turriculatus* Zone.

Lithostratigraphy according to the geological map: ss, Gothlandien (ie. Silurian) graptolitic shales and Orthoceras Limestones.

Inferred lithostratigraphic position: Carbonaceous Shale Formation, based on the lithology and the macrofauna present.

3. OUM DOUL-1 CORE SAMPLES

Sample: OD 1496.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 21, depth 1496m.

Lithology: Shale. Dark grey with medium grey lamminae, sub-fissile, micaceous.

Macrofauna observed: None

Age derived from the macrofauna: None

Formation: Lefdar.

Sample: OD 1612.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 22, depth 1612m.

Lithology: Shale. Dark grey with medium grey lamminae, irregular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: Draa.

Sample: OD 1612.1.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 22, depth 1612.1m.

Lithology: Shale. Dark grey with medium grey lamminae, irregular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: Draa.

Sample: OD 1809.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 24, depth 1809m.

Lithology: Shale. Medium dark grey, lamminated, sub-fissile, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: Draa.

Sample: OD 1809.3.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 24, depth 1809.3m.

Lithology: Shale. Medium dark grey, lamminated, sub-fissile, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: Draa.

Sample: OD 2409.65.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 31, depth 2409.65m.

Lithology: Shale. Medium dark grey, lamminated, sub-fissile, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: Anou Smaira.

Sample: OD 3130.65.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 42, depth 3130.65m.

Lithology: Shale. Medium dark grey, irregular break, slightly micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: N'Kheila.

Sample: OD 3131.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 42, depth 3131m.

Lithology: Shale. Medium dark grey, lamminated, fissile, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: N'Kheila.

Sample: OD 3186.2.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 43, depth 3186.2m.

Lithology: Shale. Medium dark grey, irregular break, slightly micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: N'Kheila.

Sample: OD 3186.5.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 43, depth 3186.5m.

Lithology: Shale. Medium dark grey, irregular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: N'Kheila.

Sample: OD 3239.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 44, depth 3239m.

Lithology: Shale. Medium dark grey, irregular break, slightly micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: N'Kheila.

Sample: OD 3239.5.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 44, depth 3239.5m.

Lithology: Shale. Dark grey, irregular break, slightly micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: N'Kheila.

Sample: OD 3274.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 45, depth 3274m.

Lithology: Shale. Dark grey, irregular break, slightly micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: N'Kheila.

Sample: OD 3274.5.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 45, depth 3274.5m.

Lithology: Shale. Dark grey, irregular break, slightly micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: N'Kheila.

Sample: OD 3333.2.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 46, depth 3333.2m.

Lithology: Shale. Medium dark grey, irregular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: N'Kheila.

Sample: OD 3504.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 50, depth 3504m.

Lithology: Shale. Medium dark grey, irregular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: Mdaour el Kbir-El Ansar.

Sample: OD 3504.2.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 50, depth 3504.2m.

Lithology: Shale. Medium dark grey, irregular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: Mdaour el Kbir-El Ansar.

Sample: OD 3675.75.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 55, depth 3675.75m.

Lithology: Shale. Greyish black, irregular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: Assa.

Sample: OD 3675-3677.5.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 55, depth 3675-3677.5m.

Lithology: Shale. Greyish black, irregular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: Assa.

Sample: OD 4069.8-4071.5.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 60, depth 4069.8-4071.5m.

Lithology: Shale. Dark grey, irregular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: Lmhaifid.

Sample: OD 4070.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 60, depth 4070m.

Lithology: Shale. Dark grey, irregular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: Lmhaifid.

Sample: OD 4070.1.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 60, depth 4070.1m.

Lithology: Shale. Dark grey, irregular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: Lmhaifid.

Sample: OD 4214.5-4217.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 61, depth 4214.5-4217m.

Lithology: Shale. Dark grey, irregular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: Lmhaifid.

Sample: OD 4214.6.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 61, depth 4214.6.

Lithology: Shale. Greyish black, irregular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: Lmhaifid.

Sample: OD 4215.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 61, depth 4215m.

Lithology: Shale. Dark grey, irregular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: Lmhaifid.

Sample: OD 4215.4.

Location: Oum Doul-1; latitude 28 05' 38"N, longitude 9 52' 05"W; core 61, depth 4215.4m.

Lithology: Shale. Dark grey, irregular break, micaceous.

Macrofauna observed: None.

Age derived from the macrofauna: None.

Formation: Lmhaifid.

APPENDIX II. Topographic maps used.

Agdz, carte du Maroc 1:100 000. Ministere de l'Agriculture et de la Reforme Agraire, division de la carte. Rabat, 1968.

Alnif, carte du Maroc 1:100 000. Ministere de l'Agriculture et de la Reforme Agraire, division de la carte. Rabat, 1970.

Boumalne, carte du Maroc 1:100 000. Ministere de l'Agriculture et de la Reforme Agraire, division de la carte. Rabat, 1968.

El Gloa', carte du Maroc 1:100 000. Ministere de l'agriculture, division du cadastre et de la cartographie. Rabat, 1972.

Erfoud, carte du Maroc 1:100 000. Ministere de l'Agriculture et de la Reforme Agraire, division de la carte. Rabat, 1970.

Fask, carte du Maroc 1:100 000. Institut Geographique National. Paris, 1970.

Foum Zguit, carte du Maroc 1:100 000. Ministere de l'agriculture, division du cadastre et de la cartographie. Rabat, 1972.

Hassi Bou Al M'Amra, carte du Maroc 1:100 000. Ministere de l'Agriculture et de la Reforme Agraire, division de la carte. Rabat, 1970.

Mdauoer, carte du Maroc 1:100 000. Ministere de l'Agriculture et de la Reforme Agraire, division de la carte. Rabat, 1970.

Msissi, carte du Maroc 1:100 000. Ministere de l'Agriculture et de la Reforme Agraire, division de la carte. Rabat, 1968.

Tarhbalt, carte du Maroc 1:100 000. Ministere de l'Agriculture et de la Reforme Agraire, division de la carte. Rabat, 1972.

Tata, carte du Maroc 1:100 000. Ministere de l'Agriculture et de la Reforme Agraire, division de la carte. Rabat, 1970.

Tazzarine, carte du Maroc 1:100 000. Ministere de l'Agriculture et de la Reforme Agraire, division de la carte. Rabat, 1973.

Tleta de Tagmoute, carte du Maroc 1:100 000. Institut Geographique National. Paris, 1969.

Zaouía Sidi Abd En Nebi, carte du Maroc 1:100 000. Institut Geographique National. Paris, 1969.

APPENDIX III. Geological maps used.

Agadir Tissinnt-Oued Zemoul, carte geologique du Maroc 1:200 000. Ministere du Commerce, de l'Industrie, des Mines et de la Marine Marchande, notes et memoires no.219. Rabat, 1971.

Akka-Tafagount-Tata, carte geologique du Maroc 1:200 000. Ministere du Commerce, de l'Industrie, des Mines et de la Marine Marchande, notes et memoires no.163. Rabat, 1970.

Goulimine et du Dra-Inferieur, carte geologique de la Terminaison Occidentale de l'Anti-Atlas 1:200 000, notes et memoires no.90. Paris, 1956.

Jbel Saghro-Dades, carte geologique du Maroc 1:200 000. Ministere de l'Energy et des Mines, notes et memoires no.161. France, 1982.

Ouarzazate, Alougoum et Telouet sud, carte geologique du Maroc 1:200 000. Division de la Geologie, notes et memoires no.138. Rabat, 1970.

Tafilalt-Taouz, carte geologique du Maroc 1:200 000. Ministere de l'Energy et des Mines, notes et memoires no.244. Florence, 1987.

Todrha-Ma'der, carte geologique du Maroc 1:200 000. Ministere de l'Energy et des Mines, notes et memoires no.243. France, 1988.

Zagora-Coude du Dra-Hamada du Dra, carte geologique du Maroc 1:200 000. Ministere de l'Energy et des Mines, notes et memoires no.273. UK, 1989.