HCO & ASSOCIATES

HOLCOMBE COUGHLIN OLIVER

Database Fundamentals and Pitfalls

Or

There is a difference between a spreadsheet and a database

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- Spreadsheets are powerful, well understood, and familiar to most geologists
- Hence when time and resources are limited, spreadsheets are the low cost, easily implemented database solution to record and archive drillhole and field data

- But…

Is this a database?

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		Drill data			Structure					Assay (- = below detection)				
2	DDH_ID	Depth	Plunge	Azimuth	Type	α	β	Calc Dip	Calc dirn	Cu (ppm)	Au1	Au (int)	Interval (m)	Sample ID
3	DDH225	12.3	-65.96	202.68	S0	45	326	37.0	175.0					
4		15.7	-65.96	202.68	S3	56	235	45.0	234.0					
5		25.2	-65.96	204.9						3	-		2.3	225-1
6		27.5	-65.75	206.9						98	0.03		1	225-2
7		28.5	-65.75	206.9	S0	32	125	36.0	146.0	120	1.1		1.3	225-3
8		29.8	-63.51	204.88	S0	57	225	37.0	218.0	3	1.5	2.87	1.4	225-4
9		31.2	-63.51	204.88	Sch	40	285	61.7	112.8	332	8.4		2.3	225-5
10		33.5	-63.51	204.88	QCV	42	275	55.9	106.6	302	3.3		1.3	225-6
11		34.8	-62.86	205.51	S0	33	300	73.5	120.8	134	-		2.5	225-7
12		37.3	-62.55	206.1	S3	52	0	66.0	170.0	10	-		1.9	225-8
13		39.2	-62.55	206.1	QCV	53	10	64.7	176.6	25	-		1	225-9
14		58.5	-62.55	206.1	S0	55	15	62.4	179.6	32	0.05		0.2	225-10
15		58.7	-62.55	206.1	Sch	15	0	77.0	350.0	10	-		0.1	225-11
16		58.7	-62.55	206.1	S0	25	5	87.1	354.5					
17		58.8	-62.19	206.52	F	30	290	72.4	111.4	34	0.01		0.3	225-12
18		59.1	-61.97	206.28	Sch	46	340	70.8	155.4	52	0.009		1.2	225-13
19		60.3	-61.79	206.2	S3	48	80	53.0	225.6	136	0.02		0.3	225-14
20		60.3	-61.79	206.2	S0	45	340	71.8	155.3					
21		60.3	-61.79	206.2	Sch	38	280	61.4	107.8					
22		60.6	-61.79	206.2	S3	55	350	62.7	163.6	136	0.009		0.9	225-15
23		60.6	-61.79	206.2	S0	32	345	85.2	157.3					
24		61.5	-61.79	206.2	S0	35	285	66.0	110.0	14	-		0.7	225-16
25	DDH23	23.5	-61.79	206.2	Sch	45	395	69.4	195.7					
26		45.6	-61.55	205.52	S0	43	330	72.3	147.4					
27		62.2	-61.55	205.52	Sch	45	330	70.3	147.9	25	0.01		1	23-1
28		62.2	-61.4	206.68	S0	46	0	72.0	170.0					
29		82	-61.4	206.68	S3	37	0	81.0	170.0	10	0.02		0.4	23-2
30		82	-61.4	206.68	F	32	355	85.9	165.8					
31		82.4	-61.14	206.5	S0	37	345	80.3	157.9	34	0.009		0.3	23-3
32		82.4	-61.14	206.5	Sch	55	110	35.4	238.6					
33		82.4	-61.14	206.5	S3	35	290	68.0	113.9					
34		82.7	-60.8	205.83	S0	36	0	82.0	170.0	56	0.009		0.5	23-4
35		82.7	-60.8	205.83	Sch	48	290	61.5	126.3					
36		83.2	-60.8	205.83	S3	45	40	74.4	200.2	102	3.29	1.585	0.6	23-5
37		83.2	-60.8	205.83	S0	45	50	71.4	206.9					
38		83.2	-60	206.25	QCV	30	40	88.3	205.8					
39		83.8	-60	206.25	S0	38	345	87.1	161.2	23	0.03		1	23-6
40		83.8	-59.9	206.2	Sch	47	280	58.5	121.1					
41		83.8	-59.9	206.2	S0	37	340	87.4	157.1					
42		112	-59.9	206.2	QCV	40	280	63.8	115.8	15	0.009		0.2	23-7
43		112	-59.9	206.2	F	35	90	62.4	240.6					

No!

- At least two 1-to-1 sets of data in a single flat spreadsheet
  - Assay
  - Structure
    - See 'key'field comment below
- Split cells
  - bad enough in headings
  - disastrous in body of table
- Non-numeric data in numeric column
  - (- symbol)
- Alphanumeric numbers in non-sortable format
  - 225-1,….,225-11,….,23-1,…
  - DDH23,…,DDH225,…
- No distinct key field for related data
  - Not critical, but desirable

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15		58.7	-62.55	206.1	Sch	15	0	77.0	350.0	10	-		0.1	225-11
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38		83.2	-60	206.25	QCV	30	40	88.3	205.8					
39		83.8	-60	206.25	S0	38	345	87.1	161.2	23	0.03		1	23-6
40		83.8	-59.9	206.2	Sch	47	280	58.5	121.1					
41		83.8	-59.9	206.2	S0	37	340	87.4	157.1					
42		112	-59.9	206.2	QCV	40	280	63.8	115.8	15	0.009		0.2	23-7
43		112	-59.9	206.2	F	35	90	62.4	240.6					

Or this

No!

- Alphanumeric fractions in numeric columns
- Meaningless alphanumeric fractions
- Incomplete data in X Y columns
- What coordinates does X Y reference?

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	PNT	X	Y	LITH	COARSE NESS	HARD NESS	CLASTS	DEFN	SUL	ASP	TEXT	STR-TYPE	DIR	VLR
2	116	299605	8097252	3	2	2/3	3	3	2	1	2	1	225	10
3	116											2	270	87
4	116											2	310	60
5	116											3	160	60
6	116											4	260	08
7	116											1	286	86
8	116											1	236	35
9	117	299613	8097159	3	2	3	2	2	2	1	3	1	242	20
10	117											2	330	62
11	117											2	070	65
12	117											2	110	66
13	118	299618	8097059	3	2/4	3	2	2	3	1	3	1	060	28
14	118											2	210	88
15	118											3	265	75
16	119	299618	8096962	3	2	2	2/3	2/3	3	2	3	1	230	10
17	119											2	070	40
18	119											2	190	62
19	120	299638	8096879	2	2	1/2	3	3	0	0	0	1	225	12
20	120											2	330	62
21	120											2	265	65
22	121	299686	8097014	3	2	1/2	1	1	2	1	1	1	250	22
23	122	299662	8097059	3	2	2	2	2	2	1	3	1	250	16
24	123	299659	8097110	3	2	1/2	2	2	2	1	1	1	080	05
25	123											2	250	85
26	123											2	350	80
27	124	299661	8097172	3	2	2	3	3	2	1	2	1	250	10
28	124											2	005	70
29	124											2	300	75
30	124											3	340	60
31	125	299652	8097334	3	4/2	2	2	3	2	1	2	1	245	30
32	125											2	240	78
33	125											2	310	60
34	125											4	240	36
35	126	299492	8097409	3	2	2	1	1	1	1	1	1	265	05
36	127	299542	8097506	3	2	2	1/2	1/2	1	1	1	1	225	15
37	127											2	202	87
38	127											2	320	77

Excel spreadsheet databases

- ‘Flat’ databases - Can only show 1:1 relationships
- Therefore need to include fields for all possibilities
- Thus get loads of empty space

E.g.:

All this empty space

(increases the file size – an issue for very large databases

All these fields are needed just in case there are 3 rock types, structures, or samples at any one location

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Field Num	Easting	Northing	UTM_ WGS84 _Zone	Location	Rocktype 1	Rocktype 2	Rocktype 3	Bedding Dip	Bedding Dirn	Struct1 Type	Struct1 Dip	Struct1 dirn	Struct2 Type	Struct2 Dip	Struct2 dirn	Sample 1	Sample 2	Comment
2	1	336456	7769234	55	Bruce Hwy, 31.5km N of Mackay	sandstone	rhyolite dyke		23	123	FR	45	6o	CLE	45	225	RH009		
3	2	336336	7769434	55	Bruce Hwy, 37.8km N of Mackay	sandstone			-	?							JJ001		weathered
4	2a	336466	7768124	55	Bruce Hwy, 43.7km N of Mackay	siltstone	minor ss	minor cgl	56	234							RH010		
5	3	336456	7769134	56	Coast Rd, 2.1km S of Yeppoon	sltst	ss												
6	4	336356	7769221	56	Coast Rd, 2.8km S of Yeppoon	ss			78	342	Contact		340				RH234		

Do not mix numbers and characters in locations (can’t sort data easily)

Remember somewhere to indicate datums, and UTM zones if ambiguous (else may not be able to plot on a digital map)

Be consistent with spelling within fields: else can’t query efficiently

Don’t put non-numeric characters into numeric fields: interferes with sorting and processing, and may turn a numeric field into a non-numeric field. Be careful to distinguish 0 from o, 1 from l, etc

Good practice: use sample numbers that identify the owner and are in a sortable format

What is a Database?

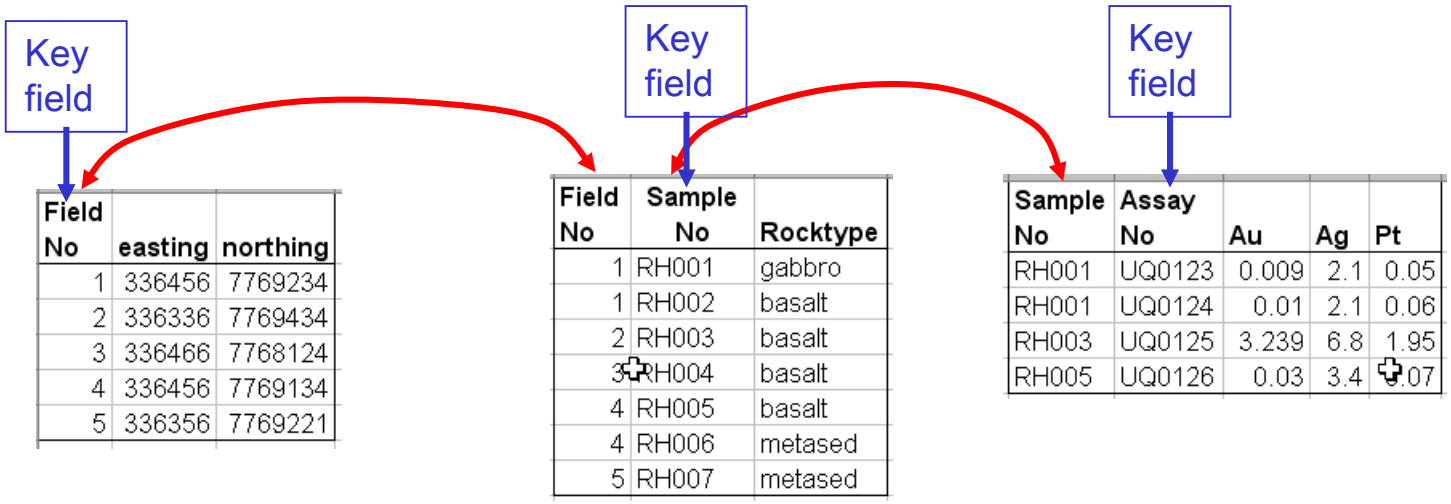
- **Consist of:**
  - One or more Tables of basic data
    - spreadsheet-like Fields (columns) and Records (rows)
    - structured and populated following database 'rules'
    - e.g. Relational Databases:
      - each Record can be uniquely identified within any one Table
      - each Field contains the same Type of data (numeric, alphanumeric, date, object, etc)
      - Tables containing at least one of the same data columns can be linked to one another as if they were a single large table
        - » Uses Relationship 'rules' between the linked Tables
  - Queries: structured views of of the data, using selected fields chosen from one or more Tables, linked together using the relationships between the overlapping fields

Relational databases

- E.g. Microsoft Access, Oracle, etc
- Multiple tables (spreadsheets) for every 1-to-many relationship
- Every Table has one or more Key field(s)
  - Unique value (number or characters)
  - May combine more than one field to form the Key
- Tables can be linked by their Key values in Queries

Relational Database

- Allows new temporary tables (Queries) to be formed by linking separate 1-1 tables using their Key fields
- Tables:



Field No	easting	northing
1	336456	7769234
2	336336	7769434
3	336466	7768124
4	336456	7769134
5	336356	7769221

Field No	Sample No	Rocktype
1	RH001	gabbro
1	RH002	basalt
2	RH003	basalt
3	RH004	basalt
4	RH005	basalt
4	RH006	metased
5	RH007	metased

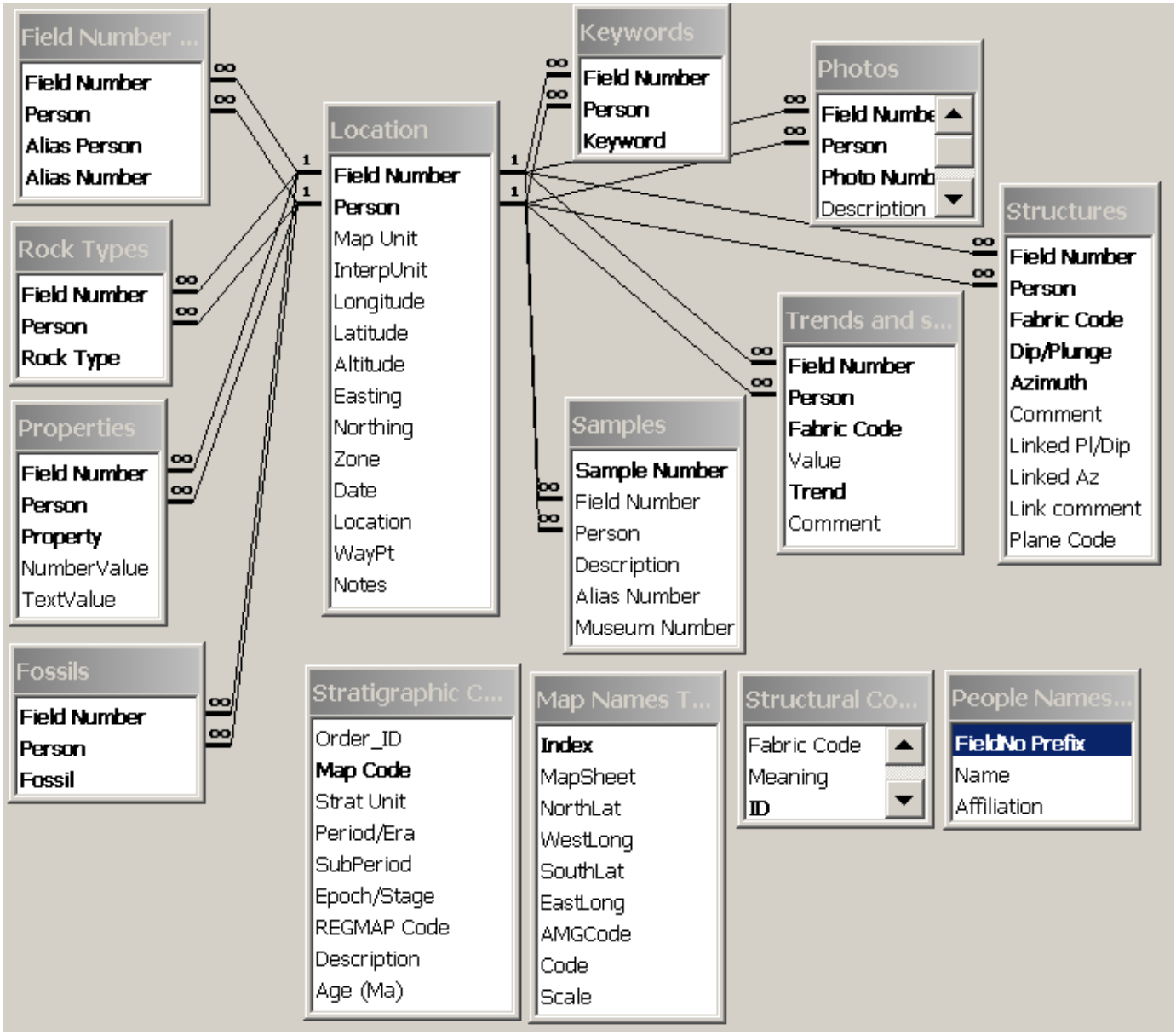
Sample No	Assay No	Au	Ag	Pt
RH001	UQ0123	0.009	2.1	0.05
RH001	UQ0124	0.01	2.1	0.06
RH003	UQ0125	3.239	6.8	1.95
RH005	UQ0126	0.03	3.4	0.07

- Query 'Table':

Rocktype	Au	easting	northing
gabbro	0.009	336456	7769234
gabbro	0.01	336456	7769234
basalt	3.239	336466	7768124
basalt	0.03	336356	7769221

  - A temporary joining of fields from the three tables

Relational Database Structure



Database design

- Poor design, even for a simple database, can lead to unwarranted cleaning-up at a later stage
- Think carefully about how you are going to Query your database - after all that's why you are doing it
- Only include those fields that will be involved in subsequent queries. The more fields you have, the more time-consuming it is to enter data.
  - in general, don't try to produce all-inclusive databases
  - databases tend to have a life that is limited to the project for which they were designed and hence extra effort may be wasted

Geographic Information Systems (GIS)

- GIS = Spatial relational databases
  - i.e exactly the same as any other relational database (RDBS) except that at least some of the Tables consist of entities with a geographic location
    - Data can be displayed as a map as well as a spreadsheet-like table
  - Separate Tables can be overlayed in map view as if they were a single map
    - This is the heart of a digital map system
  - Queries can link fields from different tables (as in any RDBS)
    - but can also select data on geographic criteria
      - such as 'Show only the data where map objects overlap'
  - Spatial Analysis of data is possible
    - Thematic mapping
      - Property distributions highlighted by colours, new symbols, contouring, etc
    - Spatial numerical analysis
      - spatial graphing

GIS - Spatial Relational Database

- E.g. MapInfo, ArcGIS, Manifold
- In addition to normal fields, Tables can have an extra field (commonly hidden) that contains geographic information about Geographic objects in the Table
  - *Point, Line, Arc, Polyline, Polygon, Region, etc*

- Geographic Information:
  - Point location or Centroid location (if a polygon object)
  - Perimeter
  - Area
  - Object contained on the left/right side of line
  - Etc

- Location information is dependent on Datums and Projections

Coordinate labels in databases

- Coordinate labels on spreadsheet or database columns should indicate the projection AND the datum
  - Assume that at some point that the data will be used by someone else
  - In the example shown at top right it is a reasonable guess that the projection is UTM – but what is the datum?
    - local alternatives are WGS84, Corrego Alegre, or SAD69
  - The example at lower right at least indicates that, in this case, the UTM guess is correct, and the datum is Corrego Alegre

PNT	X	Y	Lithotype
01	298843	8097407	2
02	298871	8097485	2
03	298909	8097512	2
20	298969	8097808	4
06	298987	8098281	2
07	298995	8098173	2
08	299000	8098096	2

PNT	Xutm_COA	Yutm_COA	Lithotype
01	298843	8097407	2
02	298871	8097485	2
03	298909	8097512	2
20	298969	8097808	4
06	298987	8098281	2
07	298995	8098173	2
08	299000	8098096	2

The UTM zone should also be referenced somewhere