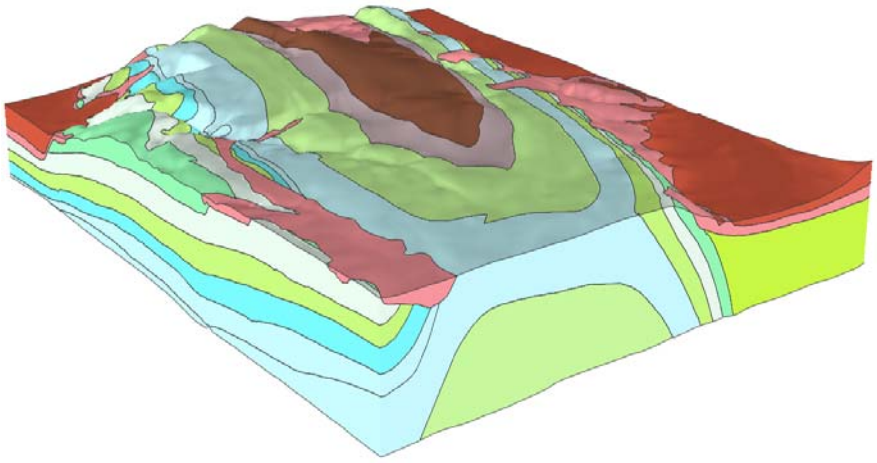
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Model Metadata Report for a 3d Model of Black Down, Mendips

Geological Modelling Systems Programme
Internal Report IR/13/006



BRITISH GEOLOGICAL SURVEY

GEOLOGICAL MODELLING SYSTEMS PROGRAMME

INTERNAL REPORT IR/13/006

Model Metadata Report for a 3d Model of Black Down, Mendips

S Thorpe

Keywords

Report; Geological Model; GSI3D; Mendips; Black Down; Bedrock.

National Grid Reference

SW corner 334912,153550
NE corner 353030,160065

Map

Sheet 280, 1:50 000 scale, Wells

Front cover

3D Model of Black Down looking from SE to NW, with Cheddar Gorge at left-hand side.

Bibliographical reference

THORPE, S. 2013. Model Metadata Report for a 3d Model of Black Down, Mendips. *British Geological Survey Internal Report*, IR/13/006. 14pp.

Keyworth, Nottingham British Geological Survey 2013

BRITISH GEOLOGICAL SURVEY

The full range of our publications is available from BGS shops at Nottingham, Edinburgh, London and Cardiff (Welsh publications only) see contact details below or shop online at www.geologyshop.com

The London Information Office also maintains a reference collection of BGS publications, including maps, for consultation.

We publish an annual catalogue of our maps and other publications; this catalogue is available online or from any of the BGS shops.

The British Geological Survey carries out the geological survey of Great Britain and Northern Ireland (the latter as an agency service for the government of Northern Ireland), and of the surrounding continental shelf, as well as basic research projects. It also undertakes programmes of technical aid in geology in developing countries.

The British Geological Survey is a component body of the Natural Environment Research Council.

British Geological Survey offices

BGS Central Enquiries Desk

Tel 0115 936 3143 Fax 0115 936 3276

email enquiries@bgs.ac.uk

Kingsley Dunham Centre, Keyworth, Nottingham NG12 5GG

Tel 0115 936 3241 Fax 0115 936 3488

email sales@bgs.ac.uk

Murchison House, West Mains Road, Edinburgh EH9 3LA

Tel 0131 667 1000 Fax 0131 668 2683

email scotsales@bgs.ac.uk

Natural History Museum, Cromwell Road, London SW7 5BD

Tel 020 7589 4090 Fax 020 7584 8270

Tel 020 7942 5344/45 email bgslondon@bgs.ac.uk

Columbus House, Greenmeadow Springs, Tongwynlais, Cardiff CF15 7NE

Tel 029 2052 1962 Fax 029 2052 1963

Maclean Building, Crowmarsh Gifford, Wallingford OX10 8BB

Tel 01491 838800 Fax 01491 692345

Geological Survey of Northern Ireland, Colby House, Stranmillis Court, Belfast BT9 5BF

Tel 028 9038 8462 Fax 028 9038 8461

www.bgs.ac.uk/gsni/

Parent Body

Natural Environment Research Council, Polaris House, North Star Avenue, Swindon SN2 1EU

Tel 01793 411500 Fax 01793 411501

www.nerc.ac.uk

Website www.bgs.ac.uk

Shop online at www.geologyshop.com

Foreword

This report is the published metadata details of a 3d modelling study by the British Geological Survey (BGS), and is based on the eastern section of the Mendips called Black Down. The model was developed under the 3d Models for Teaching team, part of the Geological Modelling Systems program at BGS. 3D geological models have great potential as a resource for universities when teaching foundation geological concepts as it allows the student to visualise and interrogate UK geology. They are especially useful when dealing with the conversion of 2D field, map and GIS outputs into three dimensional geological units, which is a common problem for all students of geology. Today's earth science students use a variety of skills and processes during their learning experience including the application of schema's, spatial thinking, image construction, detecting patterns, memorising figures, mental manipulation and interpretation, making predictions and deducing the orientation of themselves and the rocks. 3D geological models can reinforce spatial thinking strategies and encourage students to think about processes and properties, in turn helping the student to recognise pre-learnt geological principles in the field and to convert what they see at the surface into a picture of what is going on at depth.

Acknowledgements

A number of individuals have contributed to the project. This assistance has been received at all stages of the study. In addition to the collection of data, many individuals have given their advice, and provided local knowledge. We would particularly like to thank the following:

Emma Ward

Ricky Terrington

Andy Farrant

Contents

FIGURES

TABLES

Summary

This report summarises the data and information used in the construction of the model of Black Down, and the procedures and standards used to ensure its integrity.

1 Modelled volume, purpose and scale

This model initially began life as a model of the Cheddar Gorge but it soon became apparent that the bigger picture here was how the anticline of Black Down interacts with the Gorge itself. Therefore the model was extended to provide more context and allow a more local scale model to be developed. The model concentrates on the bedrock geology which ranges from the oldest formation, the Portishead Formation, from the late-Devonian period to the Mercia Mudstone from the Triassic period. Black Down is an anticline which gives a very interesting viewpoint to the user and geologist alike, and the model depicts 12 units at a scale of 1:50 000. The model was created as a simplified conceptual model of the area, and it is intended that this be used as a teaching aid to help understand sedimentology, the idea of structural folding, erosion and weathering around Cheddar Gorge, but also be used when teaching 'honeypot' tourism and the effects on the local geology and landscape.

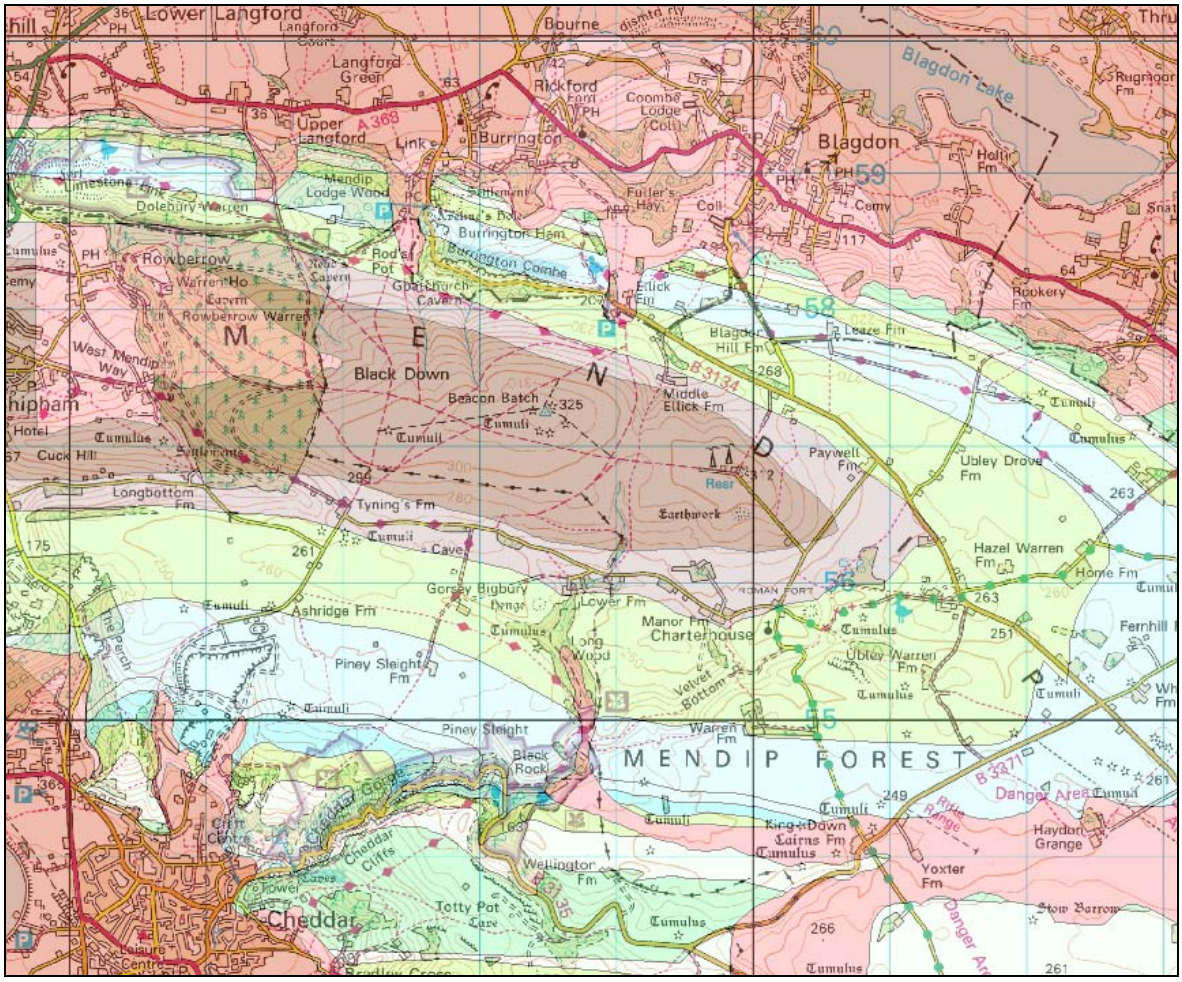


Figure 1 - Model area showing geology

2 Modelled surfaces/volumes

The model represents the currently mapped 50k scale bedrock geology. The units modelled are:

- Mercia Mudstone – mudstone and halite facies
- Mercia Mudstone – conglomerate/marginal facies
- Millstone Grit – sandstone
- Oxwich Head Limestone Formation
- Chinastones Formation
- Clifton Down Limestone Formation
- Cheddar Oolite Member
- Cheddar Limestone Member
- Burrington Oolite Subgroup
- Black Rock Limestone Subgroup
- Avon Group
- Portishead Formation

3 Model datasets

Derivation and processing of (including date and by whom):

- DTM - S Thorpe produced the 50m DTM via the GSI3D Terrain Creation tool, and subsampling the BaldEarth Model.
- Borehole data – very little borehole information is available for this area, so the model is largely constructed using dip information, mapped linework and topography.
- Map data – 50k DiGMapGB was used
- The 50k cross-section from the Wells sheet was scanned and used as a backdrop section to guide the modelling

Table 1 - GVS used in Black Down 3d Model

name	id	Stratigraphy	Lithology	Description
MMG-MDHA	1	MMG	MDHA	Mercia Mudstone Group
MMMF-CONG	5	MMMF	CONG	Mercia Mudstone Group-Marginal Facies
MG-SDST	6	MG	SDST	Millstone Grit Quartzitic Sandstone
OHL-LMST	10	OHL	LMST	Oxwich Head (Hotwells) Limestone Formation
CHI-LMST	15	CHI	LMST	Chinastones
CDL-LMST	20	CDL	LMST	Clifton Down Limestone Formation
CDRO-LMOOL	25	CDRO	LMOOL	Cheddar Oolite Member
CDRL-LMST	30	CDRL	LMST	Cheddar Limestone Member
BO-LMST	35	BO	LMST	Burrington Oolite Subgroup
BRL-LMST	40	BRL	LMST	Black Rock Limestone Subgroup
AVO-LMSD	45	AVO	LMSD	Avon Group

POB-SDST	50	POB	SDST	Portishead Formation

Table 2 - GLEG used in Black Down 3d Model

BO-LMST	Description	201	255	255	255
BRL-LMST	Description	201	255	148	255
CDL-LMST	Description	201	255	117	255
CDRL-LMST	Description	201	255	255	255
CDRO-LMOOL	Description	117	255	255	255
CHI-LMST	Description	237	255	237	255
MMG-MDHA	Description	219	84	51	255
MMMF-CONG	Description	255	148	148	255
OHL-LMST	Description	148	255	176	255
POB-SDST	Description	148	84	51	255
BO	Description	201	255	255	255
BRL	Description	201	255	148	255
CDL	Description	201	255	117	255
CDRL	Description	201	255	255	255
CDRO	Description	117	255	255	255
CHI	Description	237	255	237	255
MMG	Description	219	84	51	255
MMMF	Description	255	148	148	255
OHL	Description	148	255	176	255
POB	Description	148	84	51	255
LMST	Description	176	255	255	255
LMOOL	Description	201	219	219	255
MDHA	Description	255	148	148	255
CONG	Description	255	201	219	255
SDST	Description	255	148	176	255
AVO-LMSD	Avon Group	201	176	176	255
AVO-LSMD	Avon Group	201	176	176	255
AVO	Description	201	176	176	255
LSMD	Description	176	219	201	255
LMSD	Description	176	219	201	255
MG-SDST	Description	204	255	51	255
MG	Description	204	255	51	255
Mercia Mudstone Group	Description	219	84	51	255
Mercia Mudstone Group-Marginal Facies	Description	255	148	148	255
Millstone Grit Quartzitic Sandstone	Description	204	255	51	255
Oxwich Head (Hotwells) Limestone Formation	Description	148	255	176	255
Chinastones	Description	237	255	237	255
Clifton Down Limestone Formation	Description	201	255	117	255
Cheddar Oolite Member	Description	117	255	255	255
Cheddar Limestone Member	Description	201	255	255	255
Burrington Oolite Subgroup	Description	201	255	255	255
Black Rock Limestone Subgroup	Description	201	255	148	255
Avon Group	Description	201	176	176	255
Portishead Formation	Description	148	84	51	255

4 Model development log

Based the model on the 50k DiGMapGB bedrock (superficial were not modelled for this task). The area for the Cheddar Gorge was taken from the 280 Wells 50k map. S Thorpe decided on an area that encompassed Cheddar Gorge and included some of the interesting geology around it, to give it a sense of place.

The model area chosen is NW corner – 345013,155493

SE corner – 350000, 151914

A DTM was extracted using the procedure inside GSI3D (Add Objects -> Terrain Data) and a 50m cell size was chosen.

The geology encompassed the following units

GVS

name	id	Stratigraphy	Lithology	Description
MMG-MDHA	1	MMG	MDHA	Mercia Mudstone Group
MMMF-CONG	5	MMMF	CONG	Mercia Mudstone Group-Marginal Facies
OHL-LMST	10	OHL	LMST	Oxwich Head (Hotwells) Limestone Formation
CHI-LMST	15	CHI	LMST	Chinastones
CDL-LMST	20	CDL	LMST	Clifton Down Limestone Formation
CDRO-LMOOL	25	CDRO	LMOOL	Chedder Oolite Member
CDRL-LMST	30	CDRL	LMST	Cheddar Limestone Member
BO-LMST	35	BO	LMST	Burrington Oolite Subgroup
BRL-LMST	40	BRL	LMST	Black Rock Limestone Subgroup
POB-SDST	45	POB	SDST	Portishead Formation

A GVS and GLEG were constructed using these units.

Initially faults were thought to be included as the geology is difficult to portray (with overthrusted material in the southeast) however this is to be decided on, once the rest of the geology has been properly modelled.

Section work began on 7th July 2011.

Cheddar_ST_NE_SW_1
Cheddar_ST_NW_SE_1
Cheddar_ST_East_Docker
Cheddar_ST_South_Docker
Cheddar_ST_West_Docker
Cheddar_ST_North_Docker
Cheddar_ST_N_S_1
Cheddar_ST_MMG_helper_1
Cheddar_ST_EW_1
Cheddar_ST_N_S_2
Cheddar_ST_N_S_3

Unit envelopes were constructed 8th July 2011.

18th July 2011 – S Thorpe

Further work on the sections, tidying up calculation points (excluding the difficult faulted zone)
Cheddar_ST_E_W_2
Cheddar_ST_E_W_3
Cheddar_ST_E_W_4
BRL_helper_1

19th July 2011
Cheddar_ST_E_W_5
Cheddar_ST_E_W_6

Cheddar_ST_E_W_7

Following a discussion with Andy Farrant about the difficulty of the faulted area in the southeast, it was suggested that I extend my area northwards to include the Mendip hills pericline. This is apparently a much more interesting/valuable teaching area, and it also means that I can ignore the faulted difficulties!

I will consult with Emma, to make sure that this is suitable.

Larger area decided upon and is now NW corner – 345000, 160000; SE corner – 353000, 153500

Boreholes re-analysed and new geological shapes created 27th July.

Cross-sections that fall in this new area have been extended. Both faults have been deleted as they no longer fall in the new area.

File saved as Version 2_3.gsipr

New DTM generated at 50m resolution

28th July – S Thorpe
Cross-section from ST45 1:25000 map scanned and georegistered, and added to the project to provide some guidance to cross-section modelling.

Cross-section created as Cheddar_ST_ST45_NS_section. Correlated and project saved as V2_4.gsipr

Cheddar_ST_MMG_helper_1 – borehole ST45NE6 should actually be a horizontal section not a vertical borehole. I didn't read the information correctly when inputting the boreholes!

MG-SDST unit added as this occurs above Oxwich Head Limestone; need to check this with Farrant, as this may be an incorrect term of usage for this unit.

Cheddar_ST_E_W_8 section created to run the length of Blackdown Pericline and help with POB coding.

File saved as V2_8.gsipr

29th July 2011 – S Thorpe
Cheddar_ST_E_W_8 – Does the MMG_MDHA mask the conglomerate underneath as seen over most of the other MMG areas? Correlated

Several amendments of the geology already correlated were completed. The cross-sections were amended by starting with the POB-SDST as the base and radiating along each of the cross-sections unit by unit. This made the correlating easier, and meant that the geological envelopes could be updated swiftly as the correlating was completed, enabling any changes in geological interpretation to be reflected immediately in the distributions.

Saved as V2_11.gsipr

13th September – Continued correlation of cross-sections, and preparation for today's meeting.

Added cross-section E_W_10.

Geological envelopes completed TO THEIR CURRENT CORRELATION LINES.

Saved as V2_12.gsipr

Saved as V2_13.gsipr

Removed E_W_7 cross-section as it is outside the new area now

10th October 2011
More tweaking with the cross-sections and addition of N_S 4, N_S 5 and N_S 6 moving eastwards along the model.

11th October 2011
Continuation of correlating the northern side of cross-sections to complete the model.

Week beginning 4th June 2012
Completed cross-section correlation. Some additional cross-sections were needed to help constrain the calculation further.
Model completed 13th June and passed to Andy Farrant for review/QA.

25th Feb 2013 - Following further developments with GSI3D software, the model was reviewed by ST and cross-sections were improved by snapping techniques (crossing arrows and snapping to outcrop envelopes).
A number of new sections had not been snapped initially, so this was a thorough check on the cross-section positions.

Cheddar_base_AVO – checked
Cheddar_Base_BO – checked
Cheddar_Base_BRL – checked
Cheddar_Base_CDL – checked
Cheddar_Base_CHI – checked
Cheddar_Base_MG – checked
Cheddar_Base_OHL – checked
Cheddar_outside_Docker_North
Cheddar_outside_Docker_South
Cheddar_outside_Docker_West
Cheddar_outside_Docker_East
Cheddar_ST_E_W_1
Cheddar_ST_E_W_10
Cheddar_ST_E_W_11
Cheddar_ST_E_W_12
Cheddar_ST_E_W_13
Cheddar_ST_E_W_14
Cheddar_ST_E_W_15
Cheddar_ST_E_W_16
Cheddar_ST_E_W_17
Cheddar_ST_E_W_2
Cheddar_ST_E_W_3
Cheddar_ST_E_W_4
Cheddar_ST_E_W_5
Cheddar_ST_E_W_6
Cheddar_ST_E_W_8
Cheddar_ST_E_W_9
Cheddar_ST_MMG_helper_1
Cheddar_ST_NE_SW_1
Cheddar_ST_NW_SE_1
Cheddar_ST_N_S_1
Cheddar_ST_N_S_10
Cheddar_ST_N_S_11

Cheddar_ST_N_S_12
Cheddar_ST_N_S_13
Cheddar_ST_N_S_2
Cheddar_ST_N_S_3
Cheddar_ST_N_S_4
Cheddar_ST_N_S_5
Cheddar_ST_N_S_6
Cheddar_ST_N_S_7
Cheddar_ST_N_S_8
Cheddar_ST_N_S_9
Cheddar_ST_ST45_NS_section
Cheddar_ST_N_S_14
Cheddar_ST_N_S_17
Cheddar_ST_N_S_18

Updating GVS/GLEG with full colours for attributes.

File saved as V4_0.gsipr

Minor tweaks, removed shapefiles maps of geology. Final version saved as V4_2.gsipr

5 Model workflow

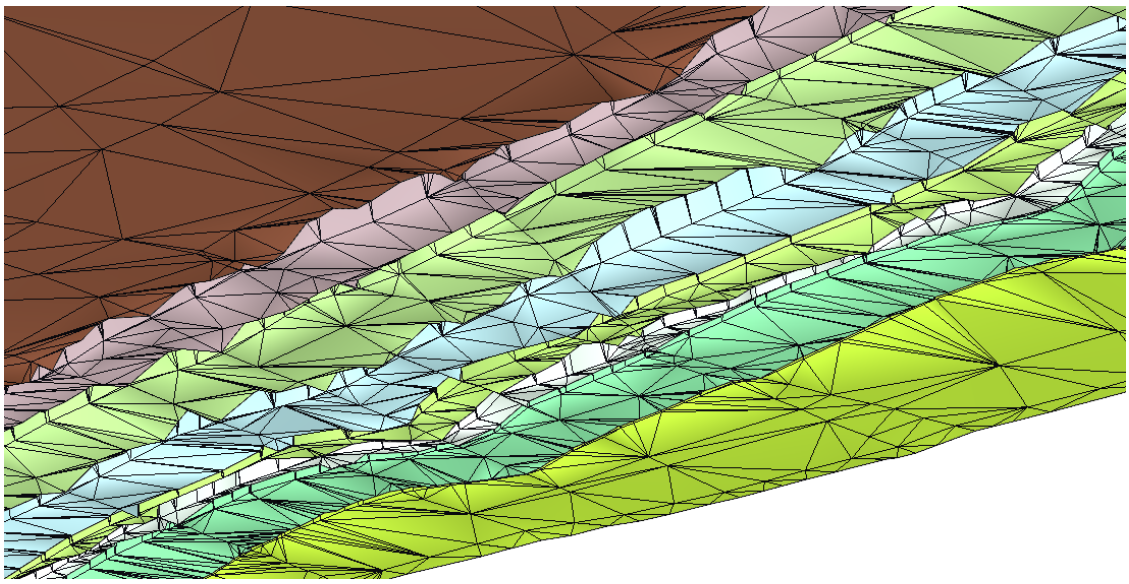
The standard GSI3D workflow for superficial geological models was followed. The DTM was allowed to shape the surface distribution of the Beach Deposit/Raised Beach relationships.

6 Model limitations

Improvements to this model could be considered by:

- Better calculation of artificially shortened unit bases. Due to the model requiring a uniform base the units are artificially stopped short of their actual depth. The units in some areas are sharply dipping and this created an awkward calculation

Figure 2 - Model as viewed from underside showing 'step' effect where two units join along a sharply dipping boundary



References

British Geological Survey holds most of the references listed below, and copies may be obtained via the library service subject to copyright legislation (contact libuser@bgs.ac.uk for details). The library catalogue is available at: http://geolib.bgs.ac.uk.

GREEN, G W & Welch, F B A. 1965. *Geology of the Country around Wells and Cheddar*. (London: HM Stationary Office)

MATHERS, S. J, WOOD, B, KESSLER, H. 2011. *GSI3D 2011 software manual and methodology*. British Geological Survey Open Report OR/11/020