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# **omf Documentation**

*Release 1.0.1*

**Global Mining Guidelines Group**

**Nov 06, 2019**



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Version: 1.0.1

API library for Open Mining Format, a new standard for mining data backed by the [Global Mining Guidelines Group](#).

**Warning: Pre-Release Notice**

Version 2 of the Open Mining Format (OMF) and the associated Python API is under active development, and subject to backwards-incompatible changes at any time. The latest stable release of Version 1 is available on [PyPI](#).



# CHAPTER 1

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Why?

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An open-source serialization format and API library to support data interchange across the entire mining community.





## CHAPTER 2

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### Scope

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This library provides an abstracted object-based interface to the underlying OMF serialization format, which enables rapid development of the interface while allowing for future changes under the hood.



## CHAPTER 3

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### Goals

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- The goal of Open Mining Format is to standardize data formats across the mining community and promote collaboration
- The goal of the API library is to provide a well-documented, object-based interface for serializing OMF files



## CHAPTER 4

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### Alternatives

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OMF is intended to supplement the many alternative closed-source file formats used in the mining community.



## CHAPTER 5

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### Connections

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This library makes use of the [properties](#) open-source project, which is designed and publicly supported by [Seequent](#).





## CHAPTER 6

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### Installation

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To install the repository, ensure that you have [pip](#) installed and run:

```
pip install omf
```

Or from [github](#):

```
git clone https://github.com/gmggroup/omf.git
cd omf
pip install -e .
```



To easily visualize OMF project files and data objects in a pure Python environment, check out [omfvista](#) which provides a module for loading OMF datasets into [PyVista](#) mesh objects for 3D visualization and analysis.

**Contents:**

### 7.1 OMF API Index

The OMF API contains tools for creating *Project* and adding *PointSet*, *LineSet*, *Surface*, and *Volume*. These different elements may have *Data* or image *Projected Texture*.

#### 7.1.1 Project

Projects contain a list of *PointSet*, *LineSet*, *Surface*, and *Volume*. Projects can be serialized to file using `OMFWriter`:

```
proj = omf.Project()
...
proj.elements = [...]
...
OMFWriter(proj, 'outfile.omf')
```

For more details on how to build a project, see the *OMF API Example*.

```
class omf.base.Project (**kwargs)
    OMF Project for serializing to .omf file
```

**Required Properties:**

- **author** (`String`): Author, a unicode string
- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime

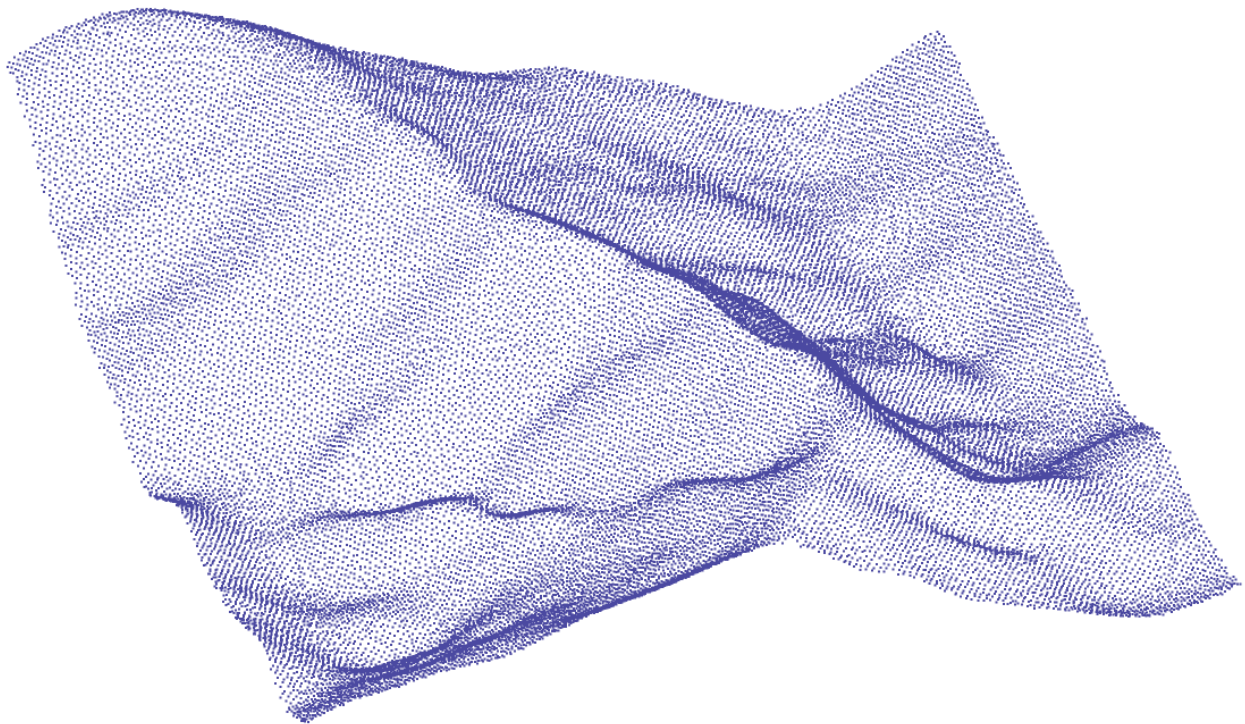
- **date\_modified** (*DateTime*): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (*String*): Description, a unicode string
- **elements** (a list of *ProjectElement*): Project Elements, a list (each item is an instance of *ProjectElement*)
- **name** (*String*): Title, a unicode string
- **origin** (*Vector3*): Origin point for all elements in the project, a 3D Vector of <type 'float'> with shape (3), Default: [0.0, 0.0, 0.0]
- **revision** (*String*): Revision, a unicode string
- **uid** (*String*): Unique identifier, a unicode string, Default: new instance of unicode
- **units** (*String*): Spatial units of project, a unicode string

**Optional Properties:**

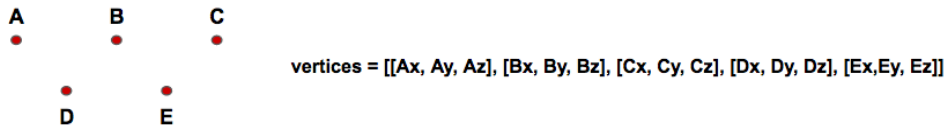
- **date** (*DateTime*): Date associated with the project data, a datetime object

## 7.1.2 PointSet

Transferring LIDAR point-cloud data from surveying software into 3D modelling software packages.



## Element



**class** `omf.pointset.PointSetElement` (*\*\*kwargs*)

Contains point set spatial information and attributes

### Required Properties:

- **color** (`Color`): Solid color, a color, Default: random
- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (`String`): Description, a unicode string
- **name** (`String`): Title, a unicode string
- **subtype** (`StringChoice`): Category of PointSet, any of “point”, “collar”, “blasthole”, Default: point
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode
- **vertices** (`Vector3Array`): Spatial coordinates of points relative to point set origin, an instance of Vector3Array

### Optional Properties:

- **data** (a list of `ProjectElementData`): Data defined on the element, a list (each item is an instance of ProjectElementData)
- **textures** (a list of `ProjectedTexture`, a list of `UVMappedTexture`): Images mapped on the element, a list (each item is an instance of ProjectedTexture or an instance of UVMappedTexture)

## Data

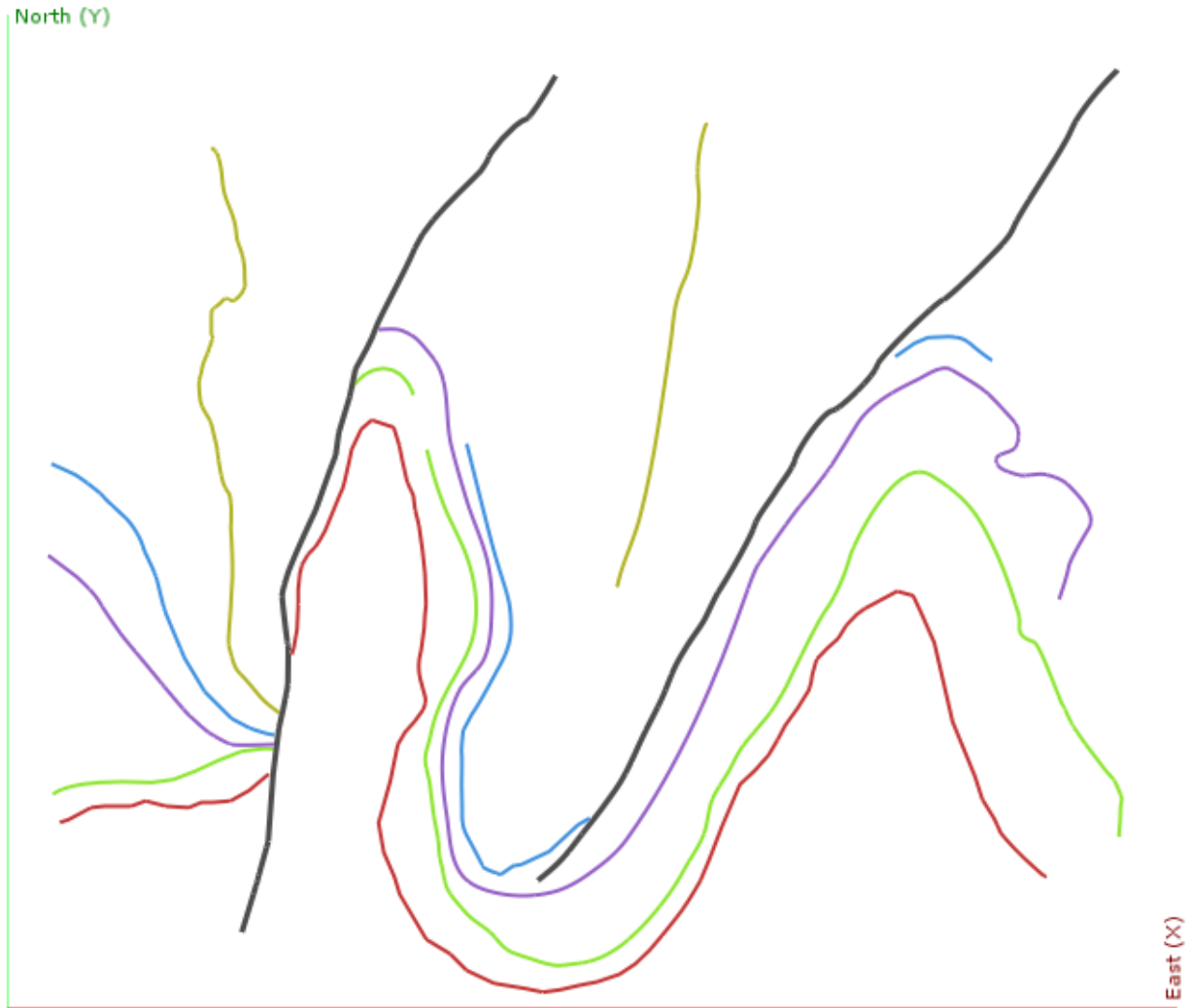
Data is a list of *data*. For PointSets, only `location='vertices'` is valid.

## Textures

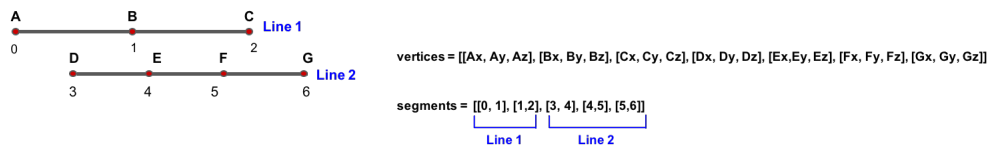
Textures are *ImageTexture* mapped to the PointSets.

### 7.1.3 LineSet

Transfer mapped geological contacts from a GIS software package into a 3D modelling software package to help construct a 3D model.



### Element



**class** `omf.lineset.LineSetElement` (*\*\*kwargs*)

Contains line set spatial information and attributes

#### Required Properties:

- **color** (`Color`): Solid color, a color, Default: random
- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime

- **description** (*String*): Description, a unicode string
- **name** (*String*): Title, a unicode string
- **subtype** (*StringChoice*): Category of LineSet, either “line” or “borehole”, Default: line
- **uid** (*String*): Unique identifier, a unicode string, Default: new instance of unicode
- **vertices** (*Vector3Array*): Spatial coordinates of line vertices relative to line set origin, an instance of Vector3Array

**Optional Properties:**

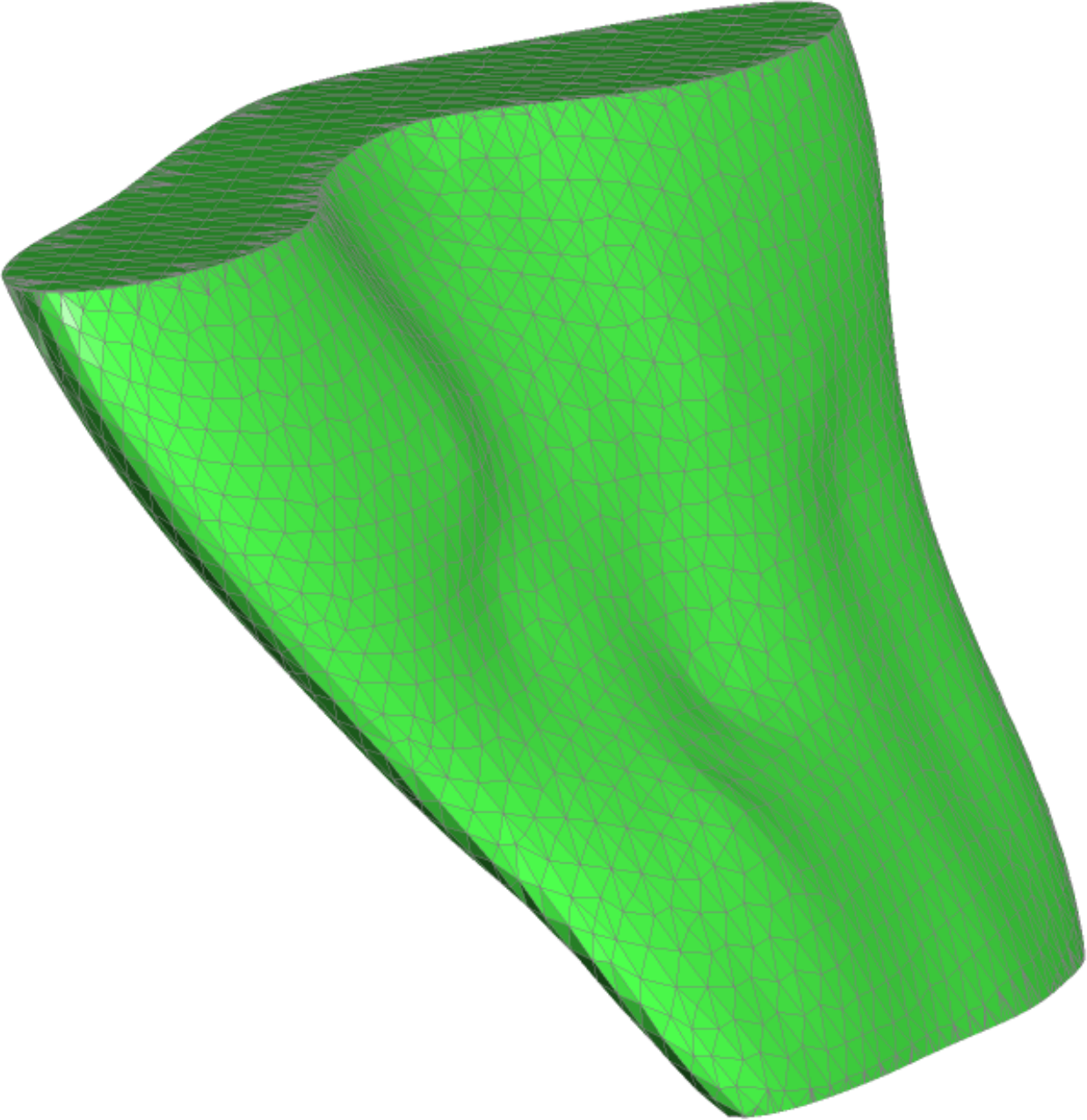
- **data** (a list of *ProjectElementData*): Data defined on the element, a list (each item is an instance of ProjectElementData)
- **segments** (*Int2Array*): Endpoint vertex indices of line segments; if segments is not specified, the vertices are connected in order, equivalent to segments=[[0, 1], [1, 2], [2, 3], ...], an instance of Int2Array

## Data

Data is a list of *data*. For Lines, `location='vertices'` and `location='segments'` are valid.

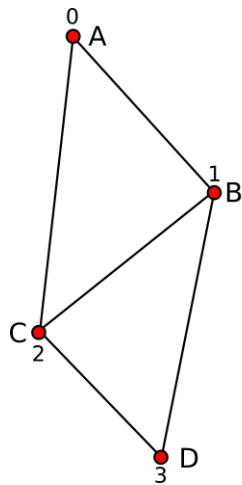
### 7.1.4 Surface

Transfer geological domains from 3D modelling software to Resource Estimation software.





## Elements



vertices = [[Ax, Ay, Az], [Bx, By, Bz], [Cx, Cy, Cz], [Dx, Dy, Dz]]

triangles = [[0, 1, 2], [1, 2, 3]]

**class** `omf.surface.SurfaceElement` (\*\*kwargs)

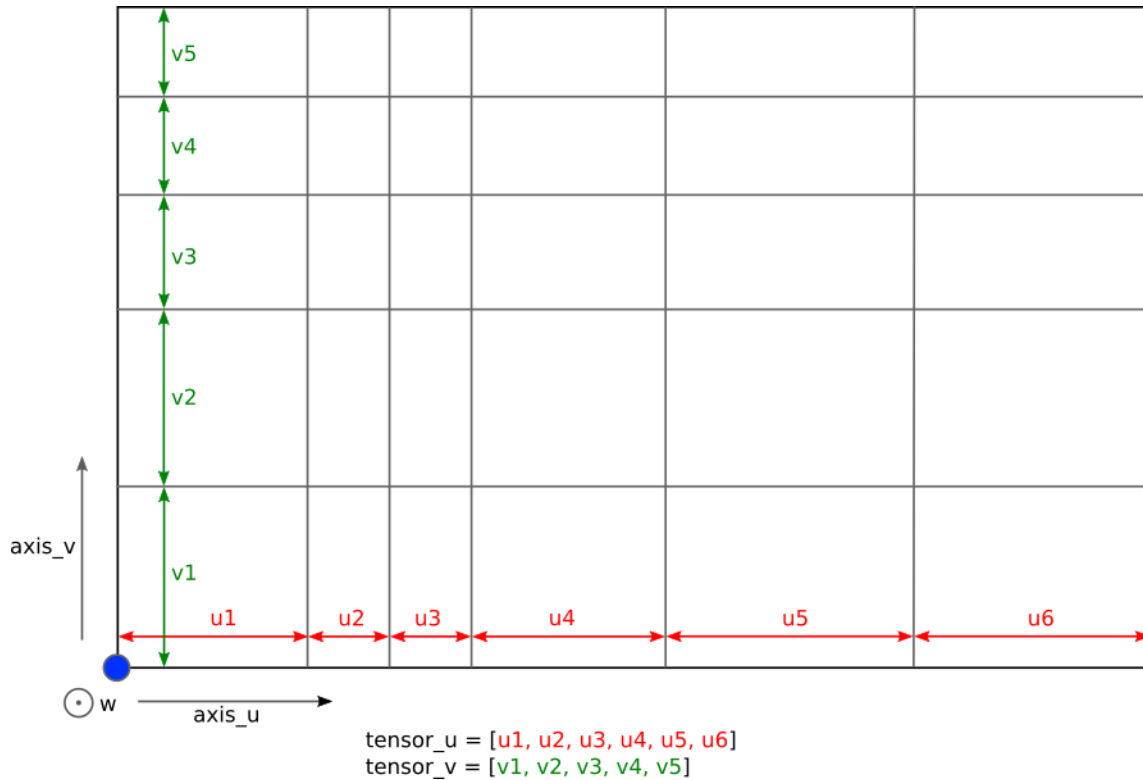
Contains triangulated surface spatial information and attributes

### Required Properties:

- **color** (`Color`): Solid color, a color, Default: random
- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (`String`): Description, a unicode string
- **name** (`String`): Title, a unicode string
- **subtype** (`StringChoice`): Category of Surface, any of “surface”, Default: surface
- **triangles** (`Int3Array`): Vertex indices of surface triangles, an instance of Int3Array
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode
- **vertices** (`Vector3Array`): Spatial coordinates of vertices relative to surface origin, an instance of Vector3Array

### Optional Properties:

- **data** (a list of `ProjectElementData`): Data defined on the element, a list (each item is an instance of ProjectElementData)
- **textures** (a list of `ProjectedTexture`, a list of `UVMappedTexture`): Images mapped on the element, a list (each item is an instance of ProjectedTexture or an instance of UVMappedTexture)



**class** `omf.surface.SurfaceGridElement` (\*\*kwargs)

Contains 2D grid spatial information and attributes

**Required Properties:**

- **axis\_u** (`Vector3`): Vector orientation of u-direction, a 3D Vector of <type 'float'> with shape (3), Default: X
- **axis\_v** (`Vector3`): Vector orientation of v-direction, a 3D Vector of <type 'float'> with shape (3), Default: Y
- **color** (`Color`): Solid color, a color, Default: random
- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (`String`): Description, a unicode string
- **name** (`String`): Title, a unicode string
- **origin** (`Vector3`): Origin of the Mesh relative to Project coordinate reference system, a 3D Vector of <type 'float'> with shape (3), Default: [0.0, 0.0, 0.0]
- **subtype** (`StringChoice`): Category of Surface, any of "surface", Default: surface
- **tensor\_u** (`Array`): Grid cell widths, u-direction, a list or numpy array of <type 'float'> with shape (\*)
- **tensor\_v** (`Array`): Grid cell widths, v-direction, a list or numpy array of <type 'float'> with shape (\*)
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode

**Optional Properties:**

- **data** (a list of *ProjectElementData*): Data defined on the element, a list (each item is an instance of *ProjectElementData*)
- **offset\_w** (*ScalarArray*): Node offset, an instance of *ScalarArray*
- **textures** (a list of *ProjectedTexture*, a list of *UVMappedTexture*): Images mapped on the element, a list (each item is an instance of *ProjectedTexture* or an instance of *UVMappedTexture*)

## Data

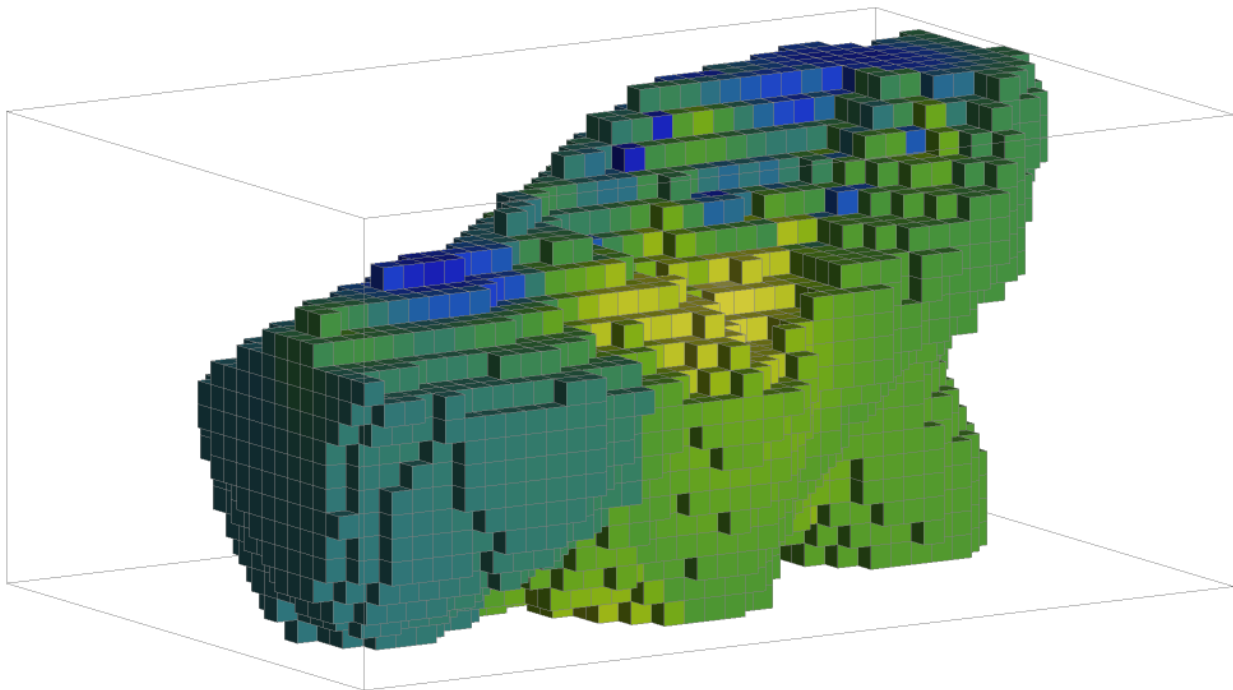
Data is a list of *data*. For Surfaces, `location='vertices'` and `location='faces'` are valid.

## Textures

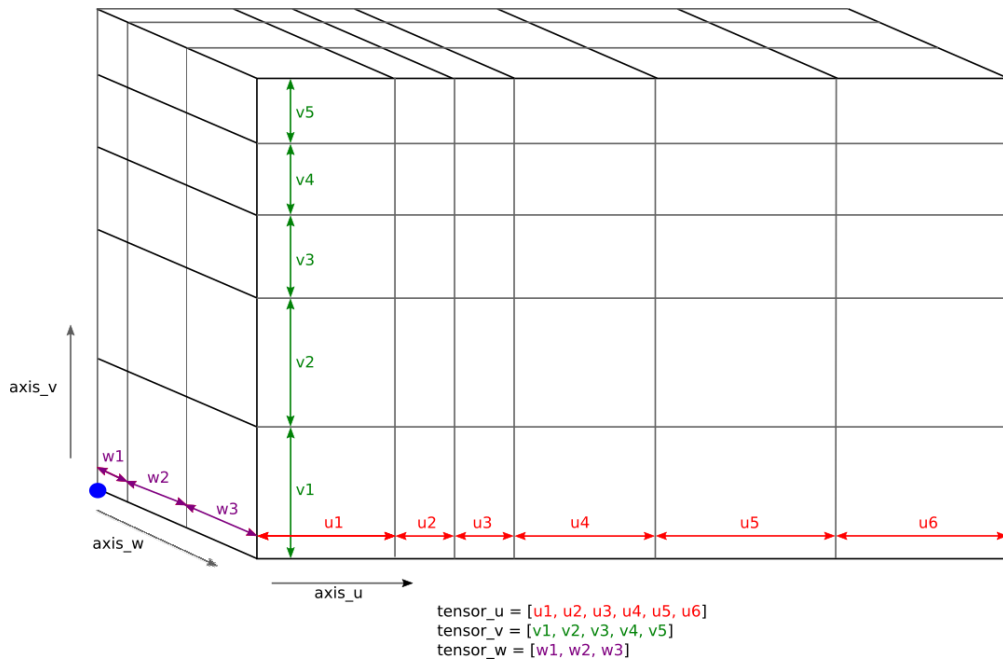
Textures are *ImageTexture* mapped to the Surface.

### 7.1.5 Volume

Transferring a block model from Resource Estimation software into Mine planning software.



## Element



**class** `omf.volume.VolumeGridElement` (\*\*kwargs)  
 Contains 3D grid volume spatial information and attributes

**Required Properties:**

- **axis\_u** (`Vector3`): Vector orientation of u-direction, a 3D Vector of <type 'float'> with shape (3), Default: X
- **axis\_v** (`Vector3`): Vector orientation of v-direction, a 3D Vector of <type 'float'> with shape (3), Default: Y
- **axis\_w** (`Vector3`): Vector orientation of w-direction, a 3D Vector of <type 'float'> with shape (3), Default: Z
- **color** (`Color`): Solid color, a color, Default: random
- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (`String`): Description, a unicode string
- **name** (`String`): Title, a unicode string
- **origin** (`Vector3`): Origin of the Mesh relative to Project coordinate reference system, a 3D Vector of <type 'float'> with shape (3), Default: [0.0, 0.0, 0.0]
- **subtype** (`StringChoice`): Category of Volume, any of "volume", Default: volume
- **tensor\_u** (`Array`): Tensor cell widths, u-direction, a list or numpy array of <type 'float'> with shape (\*)
- **tensor\_v** (`Array`): Tensor cell widths, v-direction, a list or numpy array of <type 'float'> with shape (\*)
- **tensor\_w** (`Array`): Tensor cell widths, w-direction, a list or numpy array of <type 'float'> with shape (\*)
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode

**Optional Properties:**

- **data** (a list of *ProjectElementData*): Data defined on the element, a list (each item is an instance of *ProjectElementData*)

**class** `omf.blockmodel.RegularBlockModel (**kwargs)`  
Block model with constant spacing in each dimension

**Required Properties:**

- **color** (*Color*): Solid color, a color, Default: random
- **date\_created** (*DateTime*): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (*DateTime*): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (*String*): Description, a unicode string
- **name** (*String*): Title, a unicode string
- **num\_blocks** (a list of *Integer*): Number of blocks along u, v, and w axes, a list (each item is an integer in range [1, inf]) with length of 3
- **size\_blocks** (a list of *Float*): Size of blocks in the u, v, and w dimensions, a list (each item is a float in range [0, inf]) with length of 3
- **uid** (*String*): Unique identifier, a unicode string, Default: new instance of unicode

**Optional Properties:**

- **data** (a list of *ProjectElementData*): Data defined on the element, a list (each item is an instance of *ProjectElementData*)

**Other Properties:**

- **cbc** (dynamic *Array*): Compressed block count - for regular block models this must have length equal to the product of `num_blocks` and all values must be 1 (if attributes exist on the block) or 0; the default is an array of 1s, a list or numpy array of <type 'int'>, <type 'bool'> with shape (\*) created dynamically
- **cbi** (dynamic *Array*): Compressed block index - used for indexing attributes into the block model; must have length equal to the product of `num_blocks` plus 1 and monotonically increasing, a list or numpy array of <type 'int'> with shape (\*) created dynamically

**Data**

Data is a list of *data*. For Volumes, `location='vertices'` and `location='cells'` are valid.

**7.1.6 Composite Element**

Composite Elements are used to compose multiple other elements into a single, more complex, grouped object.

**Element**

**class** `omf.composite.CompositeElement (**kwargs)`  
Element constructed from other primitive elements

**Required Properties:**

- **color** (*Color*): Solid color, a color, Default: random

- **date\_created** (*DateTime*): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (*DateTime*): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (*String*): Description, a unicode string
- **elements** (a list of *RegularBlockModel*, a list of *LineSetElement*, a list of *PointSetElement*, a list of *SurfaceElement*, a list of *SurfaceGridElement*, a list of *VolumeGridElement*): Elements grouped into one composite element, a list (each item is an instance of *RegularBlockModel* or an instance of *LineSetElement* or an instance of *PointSetElement* or an instance of *SurfaceElement* or an instance of *SurfaceGridElement* or an instance of *VolumeGridElement*)
- **name** (*String*): Title, a unicode string
- **uid** (*String*): Unique identifier, a unicode string, Default: new instance of unicode

#### Optional Properties:

- **data** (a list of *ProjectElementData*): Data defined on the element, a list (each item is an instance of *ProjectElementData*)

## Data

Data is a list of *data*. For Composite Elements, only `location='elements'` is valid. However, Data may also be defined on the child `elements`

### 7.1.7 Data

ProjectElements include a list of *ProjectElementData*. These specify mesh location ('vertices', 'faces', etc.) as well as the array, name, and description. See class descriptions below for specific types of Data.

Mapping array values to a mesh is straightforward for unstructured meshes (those defined by vertices, segments, triangles, etc); the order of the data array simply corresponds to the order of the associated mesh parameter. For grid meshes, however, mapping 1D data array to the 2D or 3D grid requires correctly ordered unwrapping. The default is C-style, row-major ordering, `order='c'`. To align data this way, you may start with a numpy array that is size (x, y) for 2D data or size (x, y, z) for 3D data then use numpy's `flatten()` function with default order 'C'. Alternatively, if your data uses Fortran- or Matlab-style, column-major ordering, you may specify data `order='f'`.

Here is a code snippet to show data binding in action; this assumes the surface contains a mesh with 9 vertices and 4 faces (ie a 2x2 square grid).

```
>> ...
>> my_surface = omf.Surface(...)
>> ...
>> my_node_data = omf.ScalarData(
    name='Nine Numbers',
    array=[0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0],
    location='vertices',
    order='c' # Default
)
>> my_face_data = omf.ScalarData(
    name='Four Numbers',
    array=[0.0, 1.0, 2.0, 3.0],
    location='faces'
)
```

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```
>> my_surface.data = [
    my_face_data,
    my_node_data
]
```

## ScalarData

**class** `omf.data.ScalarData` (\*\*kwargs)

Data array with scalar values

### Required Properties:

- **array** (*ScalarArray*): scalar values at locations on a mesh (see location parameter), an instance of *ScalarArray*
- **date\_created** (*DateTime*): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (*DateTime*): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (*String*): Description, a unicode string
- **location** (*StringChoice*): Location of the data on mesh, any of “vertices”, “segments”, “faces”, “cells”, “elements”
- **name** (*String*): Title, a unicode string
- **uid** (*String*): Unique identifier, a unicode string, Default: new instance of unicode

### Optional Properties:

- **colormap** (*ScalarColormap*): colormap associated with the data, an instance of *ScalarColormap*

## Vector3Data

**class** `omf.data.Vector3Data` (\*\*kwargs)

Data array with 3D vectors

### Required Properties:

- **array** (*Vector3Array*): 3D vectors at locations on a mesh (see location parameter), an instance of *Vector3Array*
- **date\_created** (*DateTime*): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (*DateTime*): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (*String*): Description, a unicode string
- **location** (*StringChoice*): Location of the data on mesh, any of “vertices”, “segments”, “faces”, “cells”, “elements”
- **name** (*String*): Title, a unicode string
- **uid** (*String*): Unique identifier, a unicode string, Default: new instance of unicode

## Vector2Data

**class** omf.data.Vector2Data (\*\*kwargs)  
Data array with 2D vectors

### Required Properties:

- **array** (*Vector2Array*): 2D vectors at locations on a mesh (see location parameter), an instance of Vector2Array
- **date\_created** (*DateTime*): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (*DateTime*): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (*String*): Description, a unicode string
- **location** (*StringChoice*): Location of the data on mesh, any of “vertices”, “segments”, “faces”, “cells”, “elements”
- **name** (*String*): Title, a unicode string
- **uid** (*String*): Unique identifier, a unicode string, Default: new instance of unicode

## ColorData

**class** omf.data.ColorData (\*\*kwargs)  
Data array of RGB colors specified as three integers 0-255 or color

If  $n \times 3$  integers is provided, these will simply be clipped to values between 0 and 255 inclusive; invalid colors will not error. This allows fast array validation rather than slow element-by-element list validation.

Other color formats may be used (ie String or Hex colors). However, for large arrays, validation of these types will be slow.

### Required Properties:

- **array** (*Int3Array*, *ColorArray*): RGB color values at locations on a mesh (see location parameter), an instance of Int3Array or an instance of ColorArray
- **date\_created** (*DateTime*): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (*DateTime*): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (*String*): Description, a unicode string
- **location** (*StringChoice*): Location of the data on mesh, any of “vertices”, “segments”, “faces”, “cells”, “elements”
- **name** (*String*): Title, a unicode string
- **uid** (*String*): Unique identifier, a unicode string, Default: new instance of unicode

## StringData

**class** omf.data.StringData (\*\*kwargs)  
Data array with text entries



**Required Properties:**

- **array** (*StringArray*): text at locations on a mesh (see location parameter), an instance of *StringArray*
- **date\_created** (*DateTime*): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (*DateTime*): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (*String*): Description, a unicode string
- **location** (*StringChoice*): Location of the data on mesh, any of “vertices”, “segments”, “faces”, “cells”, “elements”
- **name** (*String*): Title, a unicode string
- **uid** (*String*): Unique identifier, a unicode string, Default: new instance of unicode

**DateTimeData**

**class** `omf.data.DateTimeData` (*\*\*kwargs*)

Data array with *DateTime* entries

**Required Properties:**

- **array** (*DateTimeArray*): datetimes at locations on a mesh (see location parameter), an instance of *DateTimeArray*
- **date\_created** (*DateTime*): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (*DateTime*): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (*String*): Description, a unicode string
- **location** (*StringChoice*): Location of the data on mesh, any of “vertices”, “segments”, “faces”, “cells”, “elements”
- **name** (*String*): Title, a unicode string
- **uid** (*String*): Unique identifier, a unicode string, Default: new instance of unicode

**Optional Properties:**

- **colormap** (*DateTimeColormap*): colormap associated with the data, an instance of *DateTimeColormap*

**MappedData**

**class** `omf.data.MappedData` (*\*\*kwargs*)

Data array of indices linked to legend values or -1 for no data

**Required Properties:**

- **array** (*ScalarArray*): indices into 1 or more legends for locations on a mesh, an instance of *ScalarArray*
- **date\_created** (*DateTime*): Date project was created, a datetime object, Default: new instance of datetime

- **date\_modified** (*DateTime*): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (*String*): Description, a unicode string
- **legends** (a list of *Legend*): legends into which the indices map, a list (each item is an instance of Legend)
- **location** (*StringChoice*): Location of the data on mesh, any of “vertices”, “segments”, “faces”, “cells”, “elements”
- **name** (*String*): Title, a unicode string
- **uid** (*String*): Unique identifier, a unicode string, Default: new instance of unicode

## Legend

**class** `omf.data.Legend` (*\*\*kwargs*)  
Legends to be used with DataMap indices

### Required Properties:

- **date\_created** (*DateTime*): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (*DateTime*): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (*String*): Description, a unicode string
- **name** (*String*): Title, a unicode string
- **uid** (*String*): Unique identifier, a unicode string, Default: new instance of unicode
- **values** (*ColorArray, DateTimeArray, StringArray, ScalarArray*): values for mapping indexed data, an instance of ColorArray or an instance of DateTimeArray or an instance of StringArray or an instance of ScalarArray

## ScalarColormap

**class** `omf.data.ScalarColormap` (*\*\*kwargs*)  
Length-128 color gradient with min/max values, used with ScalarData

### Required Properties:

- **date\_created** (*DateTime*): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (*DateTime*): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (*String*): Description, a unicode string
- **gradient** (*ColorArray*): length-128 ColorArray defining the gradient, an instance of ColorArray
- **limits** (a list of *Float*): Data range associated with the gradient, a list (each item is a float) with length of 2
- **name** (*String*): Title, a unicode string
- **uid** (*String*): Unique identifier, a unicode string, Default: new instance of unicode

## DateTimeColormap

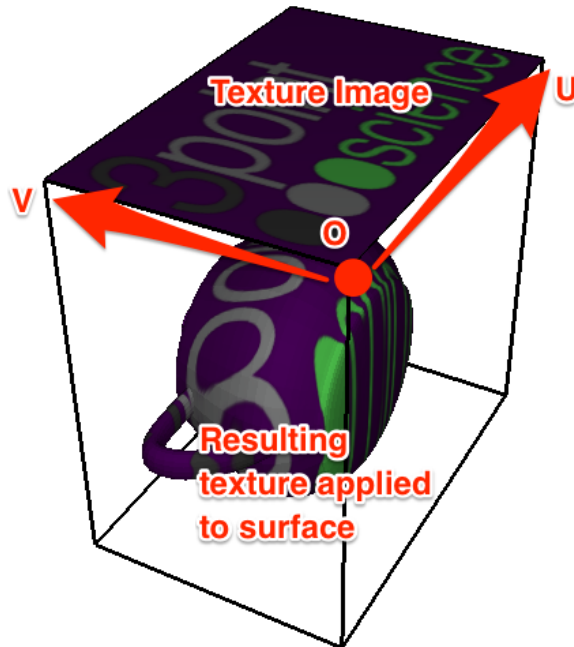
**class** `omf.data.DateTimeColormap` (\*\*kwargs)  
Length-128 color gradient with min/max values, used with `DateTimeData`

### Required Properties:

- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (`String`): Description, a unicode string
- **gradient** (`ColorArray`): length-128 `ColorArray` defining the gradient, an instance of `ColorArray`
- **limits** (a list of `DateTime`): Data range associated with the gradient, a list (each item is a datetime object) with length of 2
- **name** (`String`): Title, a unicode string
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode

## 7.1.8 Projected Texture

Projected textures are images that exist in space and are mapped to their corresponding elements. Unlike data, they do not need to correspond to mesh nodes or cell centers. This image shows how textures are mapped to a surface. Their position is defined by an origin and axis vectors then they are mapped laterally to the element position.



Like data, multiple textures can be applied to a element; simply provide a list of textures. Each of these textures provides an origin point and two extent vectors for the plane defining where images rests. The *axis\_\** properties define the extent of that image out from the origin. Given a rectangular PNG image, the *origin* is the bottom left, *origin + axis\_u* is the bottom right, and *origin + axis\_v* is the top left. This allows the image to be rotated and/or skewed. These values are independent of the corresponding Surface; in fact, there is nothing requiring the image to actually align with the Surface.

```
>> ...
>> my_surface = omf.SurfaceElement(...)
>> ...
>> my_tex_1 = omf.ProjectedImage(
    origin=[0.0, 0.0, 0.0],
    axis_u=[1.0, 0.0, 0.0],
    axis_v=[0.0, 1.0, 0.0],
    image='image1.png'
)
>> my_tex_2 = omf.ProjectedImage(
    origin=[0.0, 0.0, 0.0],
    axis_u=[1.0, 0.0, 0.0],
    axis_v=[0.0, 0.0, 1.0],
    image='image2.png'
)
>> my_surface.textures = [
    my_tex_1,
```

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```

    my_tex_2
]

```

**class** `omf.texture.ProjectedTexture` (\*\*kwargs)

Contains an image that can be projected onto a point set or surface

**Required Properties:**

- **axis\_u** (`Vector3`): Vector corresponding to the image x-axis, a 3D Vector of <type 'float'> with shape (3), Default: X
- **axis\_v** (`Vector3`): Vector corresponding to the image y-axis, a 3D Vector of <type 'float'> with shape (3), Default: Y
- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (`String`): Description, a unicode string
- **image** (`ImagePNG`): PNG image file, a PNG image file, valid modes include (u'ab+', u'rb+', u'wb+', u'rb')
- **name** (`String`): Title, a unicode string
- **origin** (`Vector3`): Origin point of the texture, a 3D Vector of <type 'float'> with shape (3), Default: [0.0, 0.0, 0.0]
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode

## 7.1.9 UV Mapped Textures

Rather than being projected onto points or a surface, UV Mapped Textures are given normalized UV coordinates which correspond to element vertices. This allows arbitrary mapping of images to surfaces.

**class** `omf.texture.UVMappedTexture` (\*\*kwargs)

Contains an image that is UV mapped to a geometry

**Required Properties:**

- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (`String`): Description, a unicode string
- **image** (`ImagePNG`): PNG image file, a PNG image file, valid modes include (u'ab+', u'rb+', u'wb+', u'rb')
- **name** (`String`): Title, a unicode string
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode
- **uv\_coordinates** (`Vector2Array`): Normalized UV coordinates mapping the image to element vertices; for values outside 0-1 the texture repeats at every integer level, and NaN indicates no texture at a vertex, an instance of `Vector2Array`

## 7.1.10 Array Types

Array classes exist allow arrays to be shared across different objects.

### ScalarArray

**class** `omf.data.ScalarArray` (*array=None, \*\*kwargs*)  
Class with unique ID and data array

#### Required Properties:

- **array** (`Array`): Shared Scalar Array, a list or numpy array of <type 'float'>, <type 'int'> with shape (\*)
- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of date-time
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode

### Vector3Array

**class** `omf.data.Vector3Array` (*array=None, \*\*kwargs*)  
Shared array of 3D vectors

#### Required Properties:

- **array** (`Vector3Array`): Shared Vector3 Array, a list of Vector3 of <type 'float'> with shape (\*, 3)
- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of date-time
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode

### Vector2Array

**class** `omf.data.Vector2Array` (*array=None, \*\*kwargs*)  
Shared array of 2D vectors

#### Required Properties:

- **array** (`Vector2Array`): Shared Vector2 Array, a list of Vector2 of <type 'float'> with shape (\*, 2)
- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of date-time
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode

## Int3Array

**class** `omf.data.Int3Array` (*array=None, \*\*kwargs*)  
 Shared n x 3 array of integers

### Required Properties:

- **array** (`Array`): Shared n x 3 Int Array, a list or numpy array of <type 'int'> with shape (\*, 3)
- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode

## Int2Array

**class** `omf.data.Int2Array` (*array=None, \*\*kwargs*)  
 Shared n x 2 array of integers

### Required Properties:

- **array** (`Array`): Shared n x 2 Int Array, a list or numpy array of <type 'int'> with shape (\*, 2)
- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode

## ColorArray

**class** `omf.data.ColorArray` (*array=None, \*\*kwargs*)  
 Shared array of Colors

### Required Properties:

- **array** (a list of `Color`): Shared array of Colors, a list (each item is a color)
- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode

## StringArray

**class** `omf.data.StringArray` (*array=None, \*\*kwargs*)  
 Shared array of text strings

### Required Properties:

- **array** (a list of `String`): Shared array of text strings, a list (each item is a unicode string)

- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode

## DateTimeArray

**class** `omf.data.DateTimeArray` (*array=None, \*\*kwargs*)

Shared array of DateTimes

### Required Properties:

- **array** (a list of `DateTime`): Shared array of DateTimes, a list (each item is a datetime object)
- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode

## 7.1.11 Other Classes

### ProjectElement

Available elements are *PointSet*, *LineSet*, *Surface*, and *Volume*; *Project* are built with elements.

**class** `omf.base.ProjectElement` (*\*\*kwargs*)

Base ProjectElement class for OMF file

ProjectElement subclasses must define their geometric definition. ProjectElements include PointSet, LineSet, Surface, and Volume

### Required Properties:

- **color** (`Color`): Solid color, a color, Default: random
- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (`String`): Description, a unicode string
- **name** (`String`): Title, a unicode string
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode

### Optional Properties:

- **data** (a list of *ProjectElementData*): Data defined on the element, a list (each item is an instance of ProjectElementData)



## ProjectElement Data

**class** `omf.base.ProjectElementData (**kwargs)`  
Data array with values at specific locations on the mesh

### Required Properties:

- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (`String`): Description, a unicode string
- **location** (`StringChoice`): Location of the data on mesh, any of “vertices”, “segments”, “faces”, “cells”, “elements”
- **name** (`String`): Title, a unicode string
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode

## Content Model

**class** `omf.base.ContentModel (**kwargs)`  
ContentModel is a UidModel with title and description

### Required Properties:

- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **description** (`String`): Description, a unicode string
- **name** (`String`): Title, a unicode string
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode

## Uid Model

UidModel gives all content a name, description, and unique uid.

**class** `omf.base.UidModel (**kwargs)`  
UidModel is a HasProperties object with uid

### Required Properties:

- **date\_created** (`DateTime`): Date project was created, a datetime object, Default: new instance of datetime
- **date\_modified** (`DateTime`): Date project was modified, a datetime object, Default: new instance of datetime
- **uid** (`String`): Unique identifier, a unicode string, Default: new instance of unicode

## 7.2 OMF API Example

This (very impractical) example shows usage of the OMF API.

Also, this example builds elements all at once. They can also be initialized with no arguments, and properties can be set one-by-one (see code snippet at bottom of page).

```
import numpy as np
import omf

proj = omf.Project(
    name='Test project',
    description='Just some assorted elements',
)

pts = omf.PointSetElement(
    name='Random Points',
    description='Just random points',
    vertices=np.random.rand(100, 3),
    data=[
        omf.ScalarData(
            name='rand data',
            array=np.random.rand(100),
            location='vertices',
        ),
        omf.ScalarData(
            name='More rand data',
            array=np.random.rand(100),
            location='vertices',
        ),
    ],
    textures=[
        omf.ImageTexture(
            name='test image',
            image='test_image.png',
            origin=[0, 0, 0],
            axis_u=[1, 0, 0],
            axis_v=[0, 1, 0],
        ),
        omf.ImageTexture(
            name='test image',
            image='test_image.png',
            origin=[0, 0, 0],
            axis_u=[1, 0, 0],
            axis_v=[0, 0, 1],
        ),
    ],
    color='green',
)

lin = omf.LineSetElement(
    name='Random Line',
    vertices=np.random.rand(100, 3),
    segments=np.floor(np.random.rand(50, 2)*100).astype(int),
    data=[
        omf.ScalarData(
            name='rand vert data',
```

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```

        array=np.random.rand(100),
        location='vertices',
    ),
    omf.ScalarData(
        name='rand segment data',
        array=np.random.rand(50),
        location='segments',
    ),
],
color='#0000FF',
)

surf = omf.SurfaceElement(
    name='trisurf',
    vertices=np.random.rand(100, 3),
    triangles=np.floor(np.random.rand(50, 3)*100).astype(int),
    data=[
        omf.ScalarData(
            name='rand vert data',
            array=np.random.rand(100),
            location='vertices',
        ),
        omf.ScalarData(
            name='rand face data',
            array=np.random.rand(50),
            location='faces',
        ),
    ],
    color=[100, 200, 200],
)

grid = omf.SurfaceGridElement(
    name='gridsurf',
    tensor_u=np.ones(10).astype(float),
    tensor_v=np.ones(15).astype(float),
    origin=[50., 50., 50.],
    axis_u=[1., 0, 0],
    axis_v=[0, 0, 1.],
    offset_w=np.random.rand(11*16),
    data=[
        omf.ScalarData(
            name='rand vert data',
            array=np.random.rand(11*16),
            location='vertices',
        ),
        omf.ScalarData(
            name='rand face data',
            array=np.random.rand(10*15),
            location='faces',
        ),
    ],
    textures=[
        omf.ImageTexture(
            name='test image',
            image='test_image.png',
            origin=[2., 2., 2.],
            axis_u=[5., 0, 0],

```

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```
        axis_v=[0, 2., 5.],
    ),
],
)

vol = omf.VolumeGridElement(
    name='vol',
    tensor_u=np.ones(10).astype(float),
    tensor_v=np.ones(15).astype(float),
    tensor_w=np.ones(20).astype(float),
    origin=[10., 10., -10],
    data=[
        omf.ScalarData(
            name='Random Data',
            location='cells',
            array=np.random.rand(10*15*20)
        ),
    ],
)

proj.elements = [pts, lin, surf, grid, vol]

assert proj.validate()

omf.OMFWriter(proj, 'omfproj.omf')
```

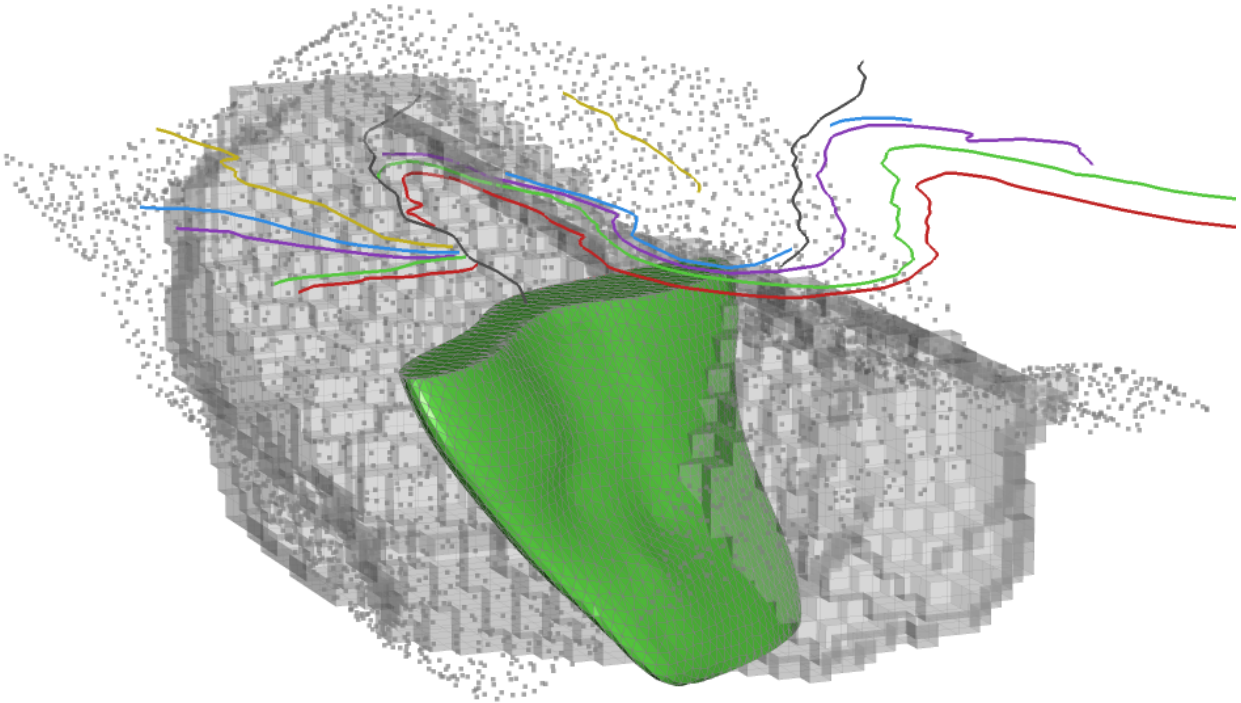
Piecewise building example:

```
...
pts = omf.PointSetElement()
pts.name = 'Random Points',
pts.vertices = np.random.rand(100, 3)
...
```

## 7.3 OMF IO API

### 7.3.1 OMF Writer

Batch export multiple different object types from a geological modeling software package.



**class** `omf.fileio.OMFWriter` (*project*, *fname*)  
 OMFWriter serializes a OMF project to a file

```
proj = omf.project()
...
omf.OMFWriter(proj, 'outfile.omf')
```

The output file starts with a 60 byte header:

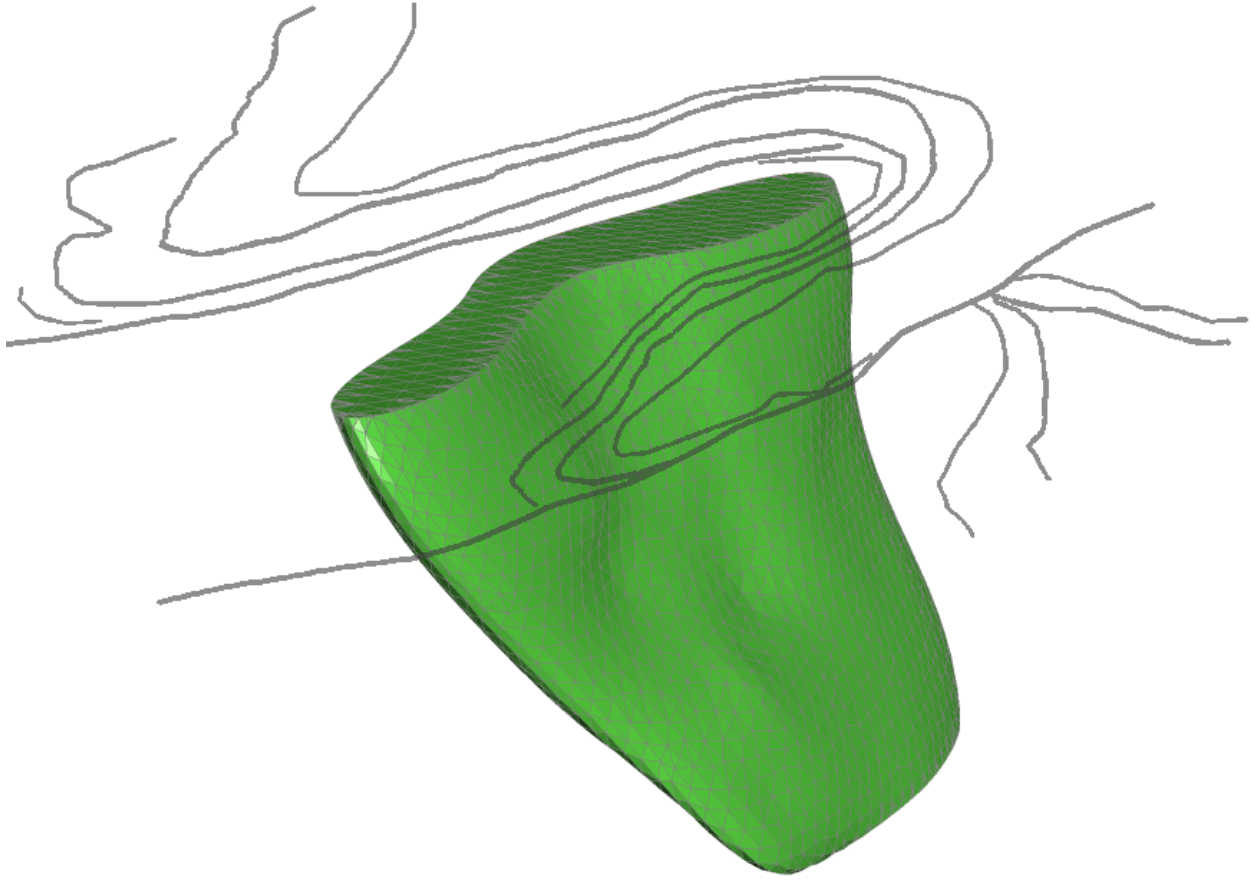
- 4 byte magic number: `b'\x81\x82\x83\x84'`
- 32 byte version string: `'OMF-v0.9.0'` (other bytes empty)
- 16 byte project uid (in little-endian bytes)
- 8 byte unsigned long long (little-endian): JSON start location in file

Following the header is a binary data blob.

Following the binary is a UTF-8 encoded JSON dictionary containing all elements of the project keyed by UID string. Objects can reference each other by UID, and arrays and images contain pointers to their data in the binary blob.

### 7.3.2 OMF Reader

Select which objects from the file are to be imported into a 3D visualization software.



**class** omf.fileio.OMFReader (*fopen*)

OMFReader deserializes an OMF file.

```
# Read all elements
reader = omf.OMFReader('infile.omf')
project = reader.get_project()

# Read all PointSets:
reader = omf.OMFReader('infile.omf')
project = reader.get_project_overview()
uids_to_import = [element.uid for element in project.elements
                  if isinstance(element, omf.PointSetElement)]
filtered_project = reader.get_project(uids_to_import)
```

## CHAPTER 8

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