

OGC® GeoPackage como alternativa a GML y SHP Ejemplos y buenas prácticas

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- SHP (¿y OGC GML?) debe morir
- OGC GeoPackage como alternativa
- Mi experiencia con OGC GeoPackage

Los Shapefiles son dinosaurios de los 90'

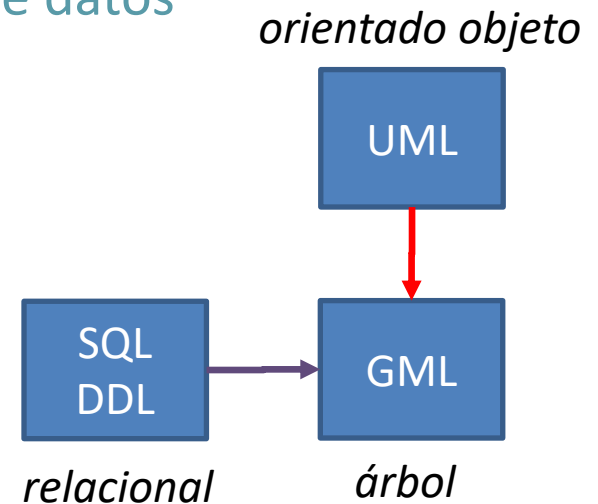
- Tabla plana con una columna espacial
- Múltiples ficheros
- Tipos de datos limitados
- No hay soporte imágenes
- Conjunto de caracteres desconocido
- Límite 32 bits: 2GB (estandar) – 4GB (OGR)
- Único tipo de geometrías ...



<http://switchfromshapefile.org/>

¿Los GML son dinosaurios de los 00'?

- GML es demasiado complejo y al mismo tiempo limitado
 - ¿Cómo representar una relación N:M?
- Procesado complejo
 - Librerías de procesado sin optimizar desde principios 10'
- Formato de intercambio de esquema/instancias
 - No resuelve interoperabilidad entre bases de datos
 - Base de datos → GML → Base de datos
- Favorece modelos no relacionales
 - Expresa información en forma de árbol



- Feature Type ***NamedPlace***
 - Un identificador (tipo complejo *Identifier*)
 - Uno o varios nombres (*GeographicalName*)
 - Una geometría (de cualquier tipo)
 - Uno o varios tipos (<<voidables>>)

- DataType ***GeographicalName***
 - Una o varias formas de escribirlo (*SpellingOfName*)

- DataType ***SpellingOfName***
 - El nombre (*text*)

- Feature Type **NamedPlace**
 - 1 SHP por tipo de geometría → Potencialmente N SHP
 - Aplanar identificador tipo *identifiser* en 3 campos
 - ¿Cómo representamos que un atributo es <<voidable>>?
- DataType **GeographicalName**
 - ¿Lo convertimos en atributo multivaluado de NamedPlace?
 - “Nombre1; Nombre2; ..”
 - Y si hay varios posibles SpellingOfName
 - “[Nombre1];[Nombre2.1; Nombre2.2]”
 - ¿Y el resto de atributos de GeographicalName?
- Pero lo podemos utilizar en cualquier sistema

- Reglas de codificación INSPIRE
 - Podemos almacenar toda la información en un único fichero
 - Podemos representar atributos complejos
 - Podemos representar relaciones

- Limitaciones
 - Documento → Relaciones parent-child
 - Reglas de validación XML → Poco expresivas
 - Soporte limitado en herramientas
 - ¿Es mantenible Base de datos → GML → Base de datos?

- GeoJSON
 - GML sin “<>” → Propuesto como estándar RFC, Ideal para Web
- CSV
 - Reemplazo ideal pero no estándar para SHP en tipos simples
- SpatiaLite
 - Librería sobre SQLite, pero no estándar
- ESRI GeoDatabase
 - Formato propietario, cerrado
- SFS+SQL dumps
 - Dependientes de la base de datos

Open Geospatial Consortium

External identifier of this OGC® document: <http://www.opengis.net/doc/IS/geopackage/1.2.1>

URL for this OGC® document: <http://www.geopackage.org/spec>

Internal reference number of this OGC® document: OGC 12-128r15

Version: 1.2.1

Category: OGC® Encoding Standard

Editor: Jeff Yutzler

Editor Emeritus: Paul Daisey

Previous Version: <http://www.opengis.net/doc/IS/geopackage/1.2.0>

Publication Date: 2018-09-06

Approval Date: 2018-06-07

Submission Date: 2018-05-16

Original Version: <http://www.opengis.net/doc/IS/geopackage/1.0>

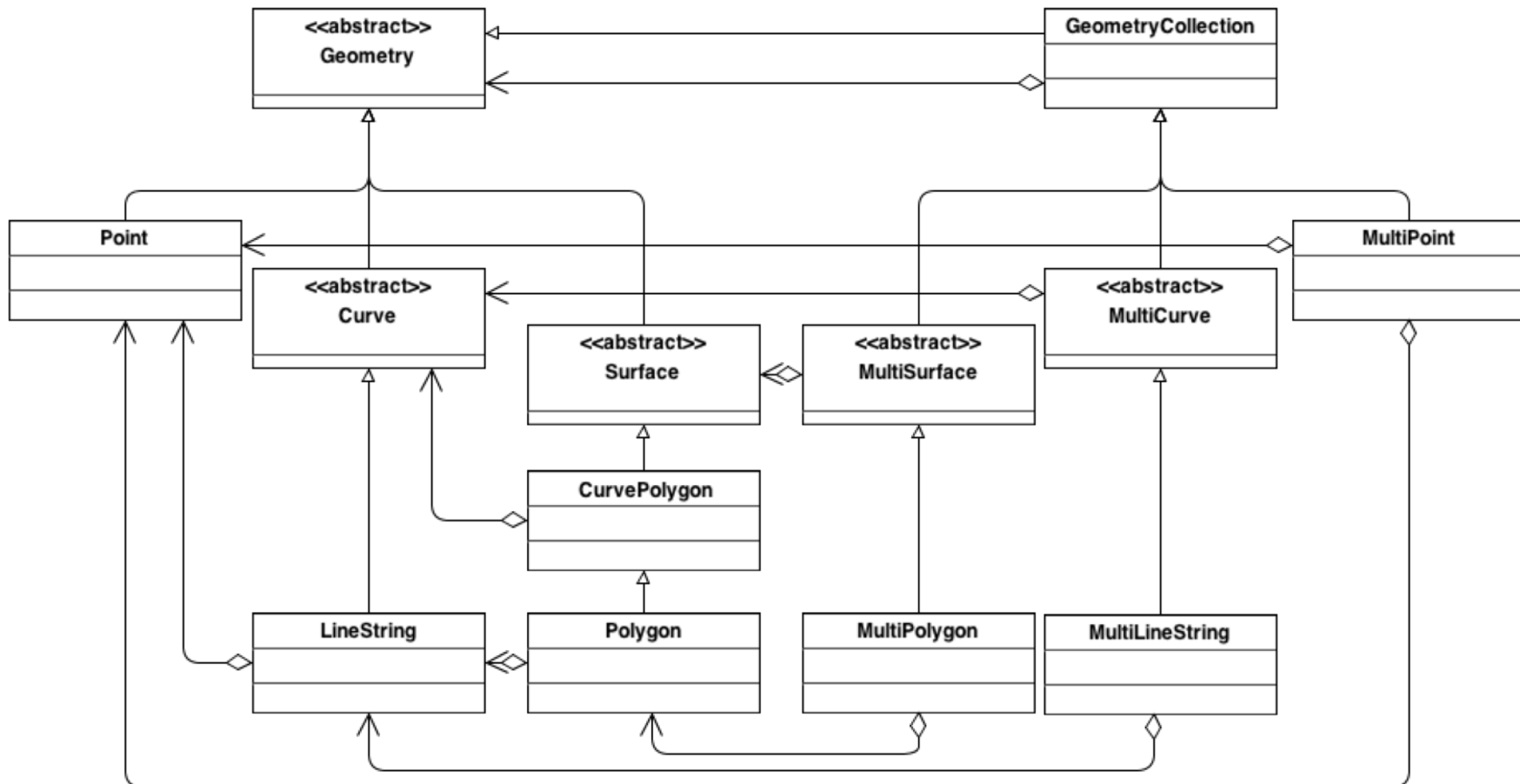
OGC® GeoPackage Encoding Standard - with Corrigendum

- Un fichero que contiene una base de datos SQLite 3
- Conforme con reglas de codificación estándar
- Puede contener
 - Datos en cualquier Sistema de referencia espacial
 - Tablas con objetos espaciales
 - Geometrías WKB
 - Piramides de teselas
 - PNG/JPEG
 - Zoom x2

- <http://www.geopackage.org/spec/>
- Reglas de codificación para almacenar en SQLite
 - Inventario del GeoPackage
 - Sistemas Espaciales de Referencia
 - Tablas de Objetos Espaciales (Features)
 - Tablas de Teselas (Tiles)
 - Tablas de Atributos
 - Extensiones y sus tablas correspondientes

- Fichero SQLite 3 marcado como “GPKG” y versión del estándar
- Extensión .gpkg
- gpkg_spatial_ref_sys
 - Define sistemas de referencia especial
- gpkg_contents
 - Identifica las tablas de datos del usuario

- Subconjunto lineal de SQL/MM (ISO 13249-3)
 - Pueden tener valores Z y M



- Licencia OGC
- SQLite 3 como almacenamiento
- Un único fichero
- Extensible → metadatos, relaciones, coverages, ...
- Soportado por múltiples herramientas → GDAL, QGIS, ArcGIS ...

- Almacenar modelos INSPIRE GN y AU en GeoPackage
 - Nomenclátor Geográfico Básico de España
 - Base de Datos de Límites Jurisdiccionales de España
- Herramientas
 - NGA GeoPackage Libraries
 - Desarrollo propio
- Resultados
 - Uso en QGIS3

- **No hay un TG en INSPIRE**
- Reglas generales → Feature, Data Type, ...
- Reutilización de modelos
 - AU importa de GN GeographicalName
 - Tipos de datos base comunes (e.g. Identifier)
- Casos especiales
 - Voidables → Extensión “Metadata”
 - Multiplicidades → Extensión “Related Tables” (draft)
 - Listas de códigos → Extensión “Schema”

- Tabla de correspondencias

| UML | Name | Type | Min | Max | Void | Identifier | Element or Content Type | |
|-----------|---|-----------------------|-----|-----|------|---|---|-------------------------------------|
| Class | NamedPlace | | | | | NamedPlace | NamedPlace | Feature |
| Attribute | NamedPlace/geometry | GM_Object | 1 | 1 | | NamedPlace/geometry | geometry | GEOMETRY |
| Attribute | NamedPlace/beginLifespanVersion | DateTime | 1 | 1 | true | NamedPlace/beginLifespanVersion | beginLifespanVersion | DATETIME |
| Attribute | NamedPlace/endLifespanVersion | DateTime | 0 | 1 | true | NamedPlace/endLifespanVersion | endLifespanVersion | DATETIME |
| Attribute | NamedPlace/leastDetailedViewingResolution | MD_Resolution | 0 | 1 | true | NamedPlace/leastDetailedViewingResolution/MD_Resolution | leastDetailedViewingResolution | TEXT(1) |
| | | | | | | NamedPlace/leastDetailedViewingResolution/MD_Resolution/equivalentScale/MD_Repr | leastDetailedViewingResolutionEquivalentScale | INTEGER |
| | | | | | | NamedPlace/leastDetailedViewingResolution/MD_Resolution/distance/Distance | leastDetailedViewingResolutionDistance | DOUBLE |
| | | | | | | NamedPlace/leastDetailedViewingResolution/MD_Resolution/distance/Distance/uom | leastDetailedViewingResolutionDistanceUom | TEXT |
| Attribute | NamedPlace/mostDetailedViewingResolution | MD_Resolution | 0 | 1 | true | NamedPlace/mostDetailedViewingResolution/MD_Resolution | mostDetailedViewingResolution | TEXT(1) |
| | | | | | | NamedPlace/mostDetailedViewingResolution/MD_Resolution/equivalentScale/MD_Repr | mostDetailedViewingResolutionEquivalentScale | INTEGER |
| | | | | | | NamedPlace/mostDetailedViewingResolution/MD_Resolution/distance/Distance | mostDetailedViewingResolutionDistance | DOUBLE |
| | | | | | | NamedPlace/mostDetailedViewingResolution/MD_Resolution/distance/Distance/uom | mostDetailedViewingResolutionDistanceUom | TEXT |
| Attribute | NamedPlace/inspireId | Identifier | 1 | 1 | | NamedPlace_inspireId | - | Relation "simple_attribute" |
| Attribute | NamedPlace/localType | LocalisedCharacterStr | 1 | * | true | NamedPlace_localType | - | Relation "simple_attribute" |
| Attribute | NamedPlace/type | NamedPlaceTypeValu | 1 | * | true | NamedPlace_type | - | Relation "simple_attribute" |
| Attribute | NamedPlace/relatedSpatialObject | Identifier | 0 | * | true | NamedPlace_relatedSpatialObject | - | Relation "simple_attribute" |
| Attribute | NamedPlace/name | GeographicalName | 1 | * | | NamedPlace_name | - | Relation "simple_attribute" |
| | | | | | | LocalType | LocalType | Attribute |
| | | | | | | LocalType/locale | locale | TEXT |
| | | | | | | LocalType/text | text | TEXT |
| | | | | | | NamedPlaceType | NamedPlaceType | Attribute |
| | | | | | | NamedPlaceType/label | label | TEXT |
| Class | GeographicalName | | | | | GeographicalName | | Attribute |
| Attribute | GeographicalName/language | CharacterString | 1 | 1 | true | GeographicalName/language | language | TEXT |
| Attribute | GeographicalName/nativeness | NativenessValue | 1 | 1 | true | GeographicalName/nativeness | nativeness | TEXT |
| Attribute | GeographicalName/nameStatus | NameStatusValue | 1 | 1 | true | GeographicalName/nameStatus | nameStatus | TEXT |
| Attribute | GeographicalName/sourceOfName | CharacterString | 1 | 1 | true | GeographicalName/sourceOfName | sourceOfName | TEXT |
| Attribute | GeographicalName/pronunciation | PronunciationOfName | 1 | 1 | true | GeographicalName/pronunciation/PronunciationOfName | pronunciation | TEXT |
| | | | | | | GeographicalName/pronunciation/PronunciationOfName/pronunciationSoundLink | pronunciationSoundLink | TEXT |
| | | | | | | GeographicalName/pronunciation/PronunciationOfName/pronunciationIPA | pronunciationIPA | TEXT |
| Attribute | GeographicalName/grammaticalGender | GrammaticalGenderV | 0 | 1 | true | GeographicalName/grammaticalGender | grammatical_gender | TEXT |
| Attribute | GeographicalName/grammaticalNumber | GrammaticalNumber | 0 | 1 | true | GeographicalName/grammaticalNumber | grammatical_number | TEXT |
| Attribute | GeographicalName/spelling | SpellingOfName | 1 | * | | GeographicalName_spelling | | Relation "simple_attributes" (Geogr |
| Class | SpellingOfName | | | | | SpellingOfName | | Attribute |
| Attribute | SpellingOfName/text | CharacterString | 1 | 1 | | SpellingOfName/text | | TEXT |
| Attribute | SpellingOfName/script | CharacterString | 1 | 1 | true | SpellingOfName/script | | TEXT |
| Attribute | SpellingOfName/transliterationScheme | CharacterString | 0 | 1 | true | SpellingOfName/transliterationScheme | | TEXT |
| | | | | | | Identifier | Identifier | Attribute |
| Attribute | NamedPlace/inspireId/localId | CharacterString | 1 | 1 | | Identifier/localId | localId | TEXT |
| Attribute | NamedPlace/inspireId/namespace | CharacterString | 1 | 1 | | Identifier/namespace | namespace | TEXT |
| Attribute | NamedPlace/inspireId/versionId | CharacterString | 0 | 1 | true | Identifier/versionId | versionId | TEXT(25) |

- Problemas del draft “Related Tables”
 - No asegura integridad referencial en relaciones
 - Añade siempre una tabla de mapeo
 - ¿¿Las tablas de atributos no deben contener valores nulos??

- Implicaciones
 - 1..N → Tabla redundante, crear un atributo que represente la relación y usar una vista
 - Atributos nulables → Tienen que tener su propia tabla
 - <<voidable>> → Complica algo su utilización en algunos escenarios

is:issue is:closed

[Labels](#)
[Milestones](#)

[New issue](#)

Clear current search query, filters, and sorts

| 18 Open 232 Closed | Author ▾ | Labels ▾ | Projects ▾ | Milestones ▾ | Assignee ▾ | Sort ▾ |
|--|----------|----------|------------|--------------|------------|--------|
| 1:N relationships by embedding User-Defined mapping tables in attribute tables #461 by fjlopez was closed 2 days ago | | | | | | 2 |
| User-Defined mapping tables may be implemented as attribute tables #460 by fjlopez was closed 2 days ago | | | | | | 2 |
| Include as requirement the table type of the related table in Related Tables Extension #459 by fjlopez was closed 2 days ago | | | | | | 2 |
| Requirement 32/Req 32 Test Clarification Needed #445 by ajanett was closed on 25 Jun 1.3.0 | | | | | | 5 |

- NGA GeoPackage
 - Unica librería certificada por OGC
 - <https://github.com/ngageoint/GeoPackage>
 - Librería de Java de uso algo “complicado”
- Mis herramientas (en Kotlin)
 - DSL para especificación de Esquemas GeoPackage
 - DSL para procesos batch de base de datos a GeoPackage
 - Copiar de base de datos a SQLite
 - Crear esquema destino
 - Ejecutar en SQLite la migración

```
package es.iaaa.m2m.geopackage.cnig.gn.config

import es.iaaa.m2m.geopackage.core.dsl.AttributeBuilder
import es.iaaa.m2m.geopackage.core.dsl.FeatureBuilder
import es.iaaa.m2m.geopackage.core.dsl.GeoPackageTypes

object GeographicNamesSchema {
  fun inspireNamedPlaceSchema(effectiveSrsId: Long): FeatureBuilder.() -> Unit = {
    tableName = "named_place"
    identifier = "Geographical Names:NamedPlace"
    description = "Any real world entity referred to by one or several proper nouns."
    srsId = effectiveSrsId
    column {
      name = "inspire_id"
      dataType = GeoPackageTypes.INT
      notNull = true
      indexed = true
    }
    column {
      name = "geometry"
      dataType = GeoPackageTypes.GEOMETRY
      notNull = true
    }
    column {
      name = "begin_lifespan_version"
      dataType = GeoPackageTypes.DATETIME
    }
    column {...}
    column {
      name = "least_detailed_viewing_resolution"
      dataType = GeoPackageTypes.TEXT
      max = 1
    }
    column {...}
    column {...}
    column {...}
    column {...}
    column {...}
    column {...}
    column {...}
  }
  val inspireNamedPlaceLocalTypeSchema: AttributeBuilder.() -> Unit = {
    tableName = "named_place_local_type"
    identifier = "Geographical Names:NamedPlace.localType"
    description = ""
  }
}
```



```
fun createInspireSchema(): Step = steps
    .get("Create INSPIRE schema in file $GPKG_FILE")
    .tasklet { _, _ ->
        GPKG_FILE.asOpenGeoPackage()
            .addFeatureTable(inspireNamedPlaceSchema(4258))
            .addAttributeTable(inspireNamedPlaceLocalTypeSchema)
            .addAttributeTable(inspireNamedPlaceTypeSchema)
            .addAttributeTable(inspireIdentifierSchema)
            .addAttributeTable(inspireNamedPlaceRelatedSpatialObjectSchema)
            .addAttributeTable(inspireGeographicalNameSchema)
            .addAttributeTable(inspireSpellingOfNameSchema)
        ^tasklet RepeatStatus.FINISHED
    }
    .build()

fun copyData(): Step = steps
    .get("Populate INSPIRE schema in file $GPKG_FILE")
    .tasklet { _, _ ->
        GPKG_FILE.asOpenGeoPackage().apply {
            sqlConsole("""
                INSERT INTO named_place(id, inspire_id, begin_lifespan_version, geometry)
                SELECT id, id, beginlifespanversion, the_geom FROM src_namedplace;

                INSERT INTO named_place_local_type(named_place_id, locale, text)
                SELECT id, 'es-ES', localtype FROM src_namedplace;

                INSERT INTO named_place_type(named_place_id, name)
                SELECT id, tipo FROM src_namedplace;

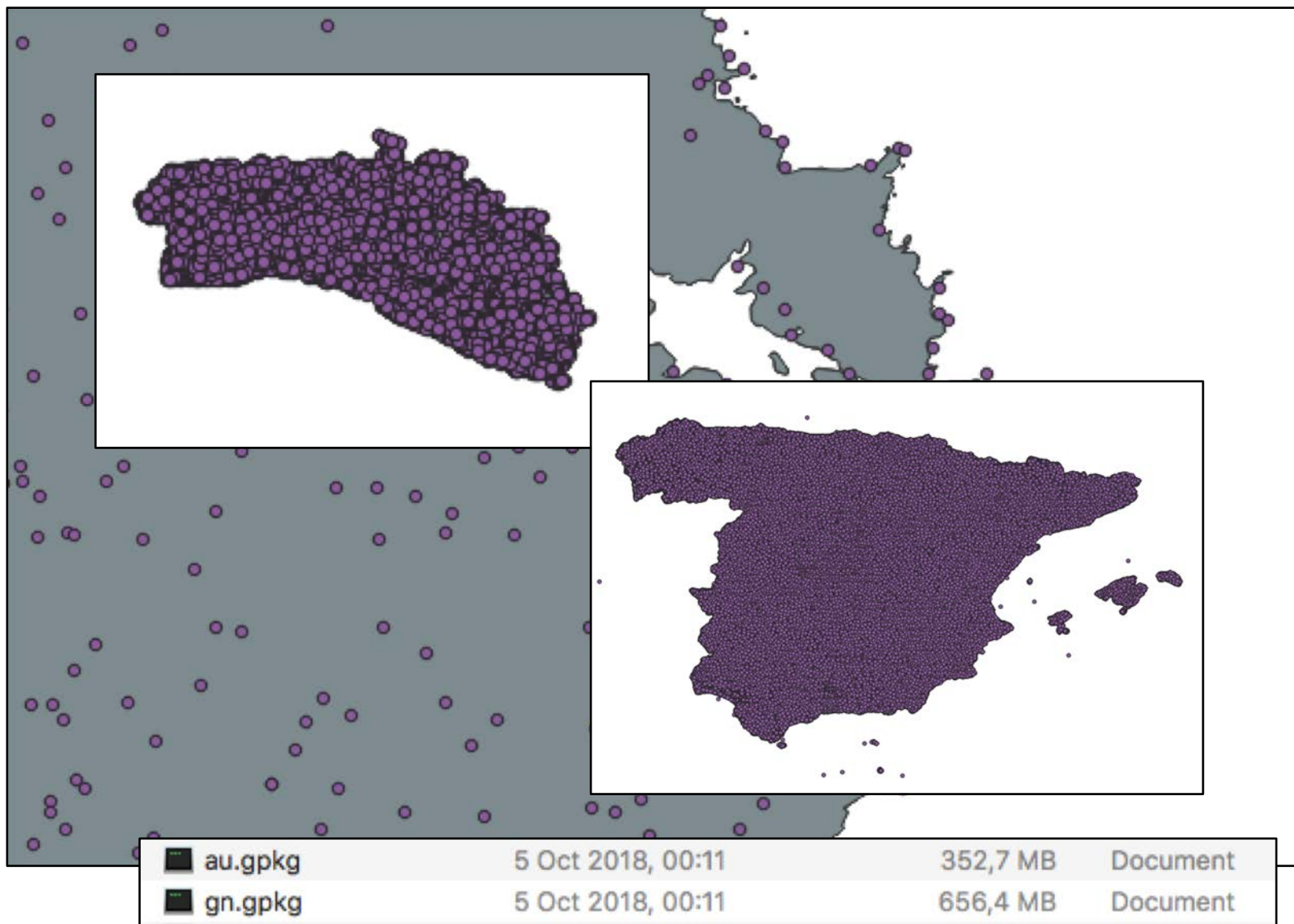
                INSERT INTO identifier(id, local_id, namespace, version_id)
                SELECT id, identidad, 'ES.IGN.NGBE', '2015' FROM src_namedplace;

                INSERT INTO geographical_name(id, name_of, name_of_table, language, nativeness, name_status, sou
                SELECT id, identidad, 'named_place', idioma, 'endonym', estatus, fuente, '', '', '', '', ''
                FROM src_geographicalname;

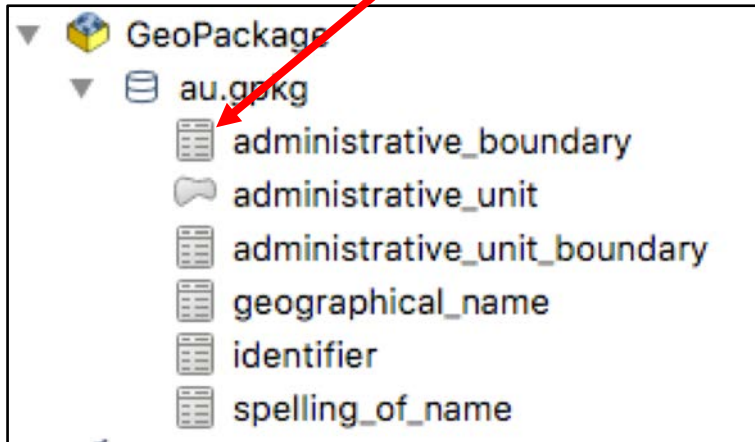
                INSERT INTO spelling_of_name(id, spelling_of, text, script, transliteration_scheme)
                SELECT id, id, nombre, 'Latn', ''
                FROM src_geographicalname;
            """).trimIndent()
        }
        ^tasklet RepeatStatus.FINISHED
    }
    .build()
```



- Pensar como un desarrollador de base de datos
 - Todo se puede hacer, sin limitaciones y rápido
- Eficiencia → Procesos de migración dentro de SQLite
 - Copiar todos los datos a SQLite
 - Reutilizar con cabeza claves primarias fuente en las tablas GeoPackage
 - Ejecutar todas las transformaciones en SQLite
- Soporte FME y similares
 - No adecuado para modelos complejos todavía
 - Procesos hay que hacerlos en destino por eficiencia



Bug de GDAL



| Setting | Value |
|------------------------------------|-------------------------------|
| ▼ Join layer | spelling_of_name |
| Join field | spelling_of |
| Target field | geographical_name_id |
| Cache join layer in virtual memory | ✓ |
| Dynamic form | |
| Editable join layer | |
| Upsert on edit | |
| Delete cascade | |
| Custom field name prefix | |
| Joined fields | 1 |
| ▼ Join layer | geographical_name |
| Join field | name_of |
| Target field | id |
| Cache join layer in virtual memory | ✓ |
| Dynamic form | |
| Editable join layer | |
| Upsert on edit | |
| Delete cascade | |
| Custom field name prefix | |
| Joined fields | 0 |
| ▼ Join layer | named_place_local_type |
| Join field | named_place_id |
| Target field | id |
| Cache join layer in virtual memory | ✓ |
| Dynamic form | |
| Editable join layer | |
| Upsert on edit | |
| Delete cascade | |



named_place - Feature Attributes

| | |
|--|---------------------|
| id | 2143309 |
| inspire_id | 2143309 |
| begin_lifespan_version | 2015-12-17 00:00:00 |
| end_lifespan_version | NULL |
| least_detailed_viewing_resolution | NULL |
| least_detailed_viewing_resolution_equivalent_scale | NULL |
| least_detailed_viewing_resolution_distance | NULL |
| least_detailed_viewing_resolution_distance_uom | NULL |
| most_detailed_viewing_resolution | NULL |
| most_detailed_viewing_resolution_equivalent_scale | NULL |
| most_detailed_viewing_resolution_distance | NULL |
| most_detailed_viewing_resolution_distance_uom | NULL |
| named_place_local_type_text | Isla |
| geographical_name_id | 881296 |
| spelling_of_name_text | Illa del Llatzeret |

Cancel OK

Gracias por su atención

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