Virtual Rocks, Virtual Outcrops, and Virtual Field Trips

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Abstract

The ability to visualize objects in 3D is fundamental in geology, but we have hardly integrated any virtual 3D tools in our courses, even though such tools have been available for years. Covid restrictions accelerated a project we were already working on: **creating a collection of 3D models of rocks and outcrops** to be used as a training aid in the classroom. Travel restrictions, which at our institution included a year-long complete ban of all field courses (including one-day trips), spurred us to expand the original concept to **include also a full 3D virtual environment for students to carry out field trips**. We took into account three factors: costs, time, and level of difficulty. That meant finding **commercial software and hardware that was affordable and did not require programming skills, engineering skills, or special licenses** (e.g. pilot license for a large drone) and, in the case of outcrops, using areas for which we already had a significant amount of material from previous years. We also decided to use **public platforms to store our 3D models** and as a source of additional models for our virtual courses.

We created 3D models of hand samples from our own rock collection, and 3D models of key outcrops at several field locations that we normally use in both Spain and Germany, using hand-held cameras and a small drone (which in Europe only requires insurance and operator's registration). Image processing to produce scaled and georeferenced models was done with Metashape Pro. Our 3D rock labs were built using the tools available in Moodle. We used instead 3DVista Virtual Tour Pro, a software originally designed for real estate showcasing, to produce immersive, interactive virtual field trips. This software allows linking our 3D models, which are stored on either Sketchfab or V3Geo, with videos, animations, photos, maps, text, and realistic sounds for each field scene. An **e-learning module** in the form of quizzes and game-like features can be incorporated too. The virtual trips can be customized: some are show-and-tell field trips, some are field exercises where students are expected to carry out measurements and observations, and others are complementary material for remote mapping courses. The **reception from students has been positive**, and we plan to keep using these tools even now that the covid crisis is over.

For the future, the most important aspect is to follow new technological development and **be prepared to adapt**. The technology changes constantly, and it is unrealistic to expect that what we build today will be usable as it is 5 years from now.

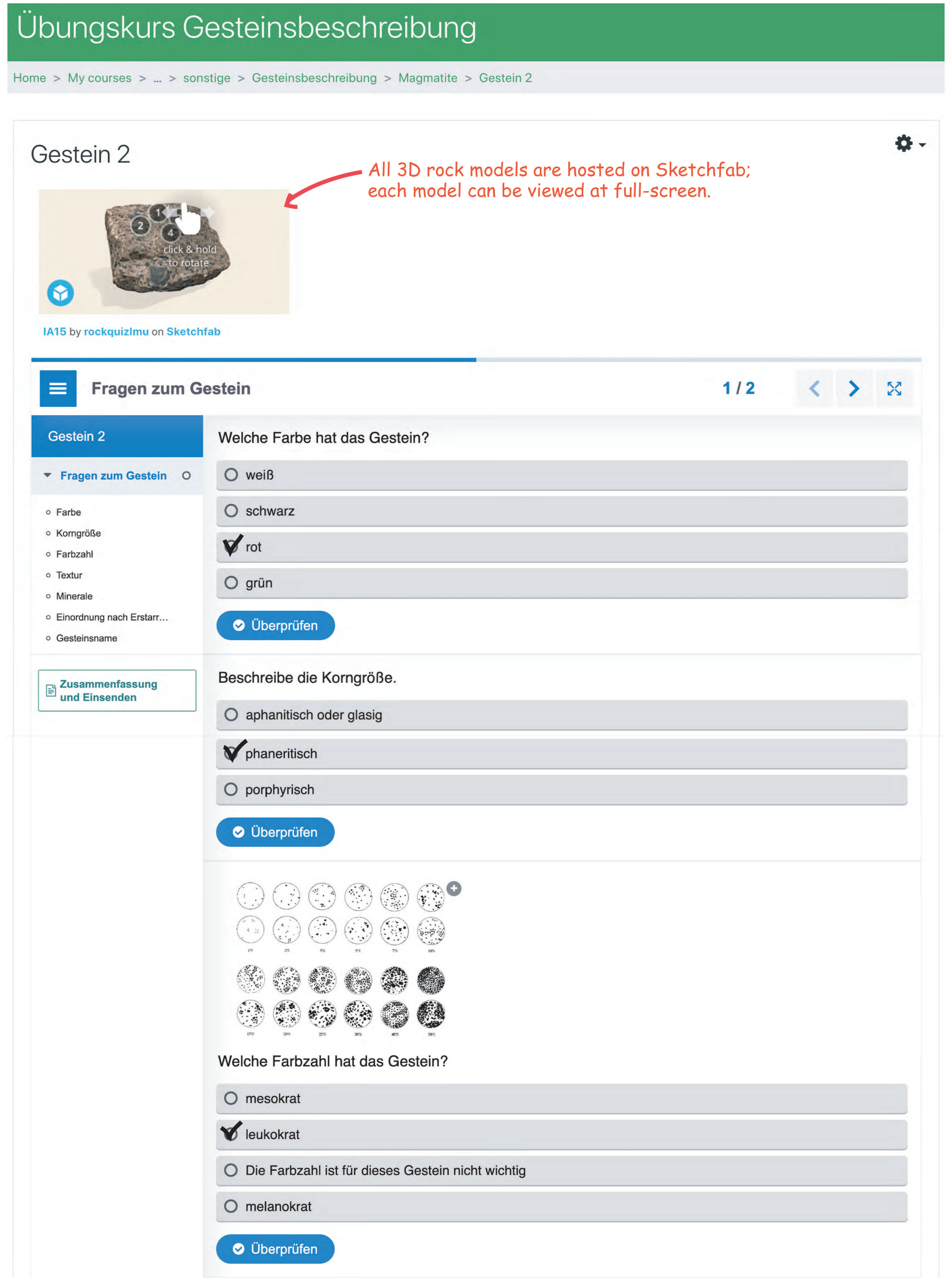
Resources

Hardware
Drones: DJI Mavic Mini, DJI Mini 2
Compact camera, cellphone camera
Mac (or Windows PC) with at least 16GB RAM

Software, web utilities, model platforms
Metashape Pro, https://www.agisoft.com
3DVista Virtual Tour Pro, https://www.3dvista.com
StreetView App (phone)
Street View Download 360 App (computer)
iStreetView, https://istreetview.com/
Sketchfab, https://sketchfab.com
V3Geo, https://v3geo.com
Moodle, https://moodle.org

SCAN ME **Making 3D rock models, NAGT webinar**

Virtual Rock Practice in Moodle



Übungskurs Gesteinsbeschreibung

Home > My courses > ... > sonstige > Gesteinsbeschreibung > Magmatite > Gestein 2

Gestein 2

All 3D rock models are hosted on Sketchfab; each model can be viewed at full-screen.

IA15 by rockquizlmu on Sketchfab

Fragen zum Gestein 1 / 2

Gestein 2
- Fragen zum Gestein
  - Farbe
  - Korngröße
  - Farbzahl
  - Textur
  - Minerale
  - Einordnung nach Erstarr...
  - Gesteinsname

Zusammenfassung und Einsenden

Welche Farbe hat das Gestein?
○ weiß
○ schwarz
✓ rot
○ grün
Überprüfen

Beschreibe die Korngröße.
○ aphanitisch oder glasig
✓ phaneritisch
○ porphyrisch
Überprüfen

Welche Farbzahl hat das Gestein?
○ mesokrat
✓ leukokrat
○ Die Farbzahl ist für dieses Gestein nicht wichtig
○ melanokrat
Überprüfen

Example of one rock model in the Moodle-based rock practice lab

In this exercise in rock description and identification, **rocks are grouped by main type** (igneous, metamorphic, sedimentary), and within each group students can practice making observations (color, mineral composition, texture, etc.) and assigning a name to the rock.
For each question (7 to 10 per sample), the user can check immediately whether the answer is correct. The course Moodle page also has a **glossary with all the terms used** in the exercise, which can be accessed at any time.
Sets of questions are similar within each rock type group, with occasional adaptations for specific rocks (e.g. obsidian, where the characteristic fracture is also part of the question set).

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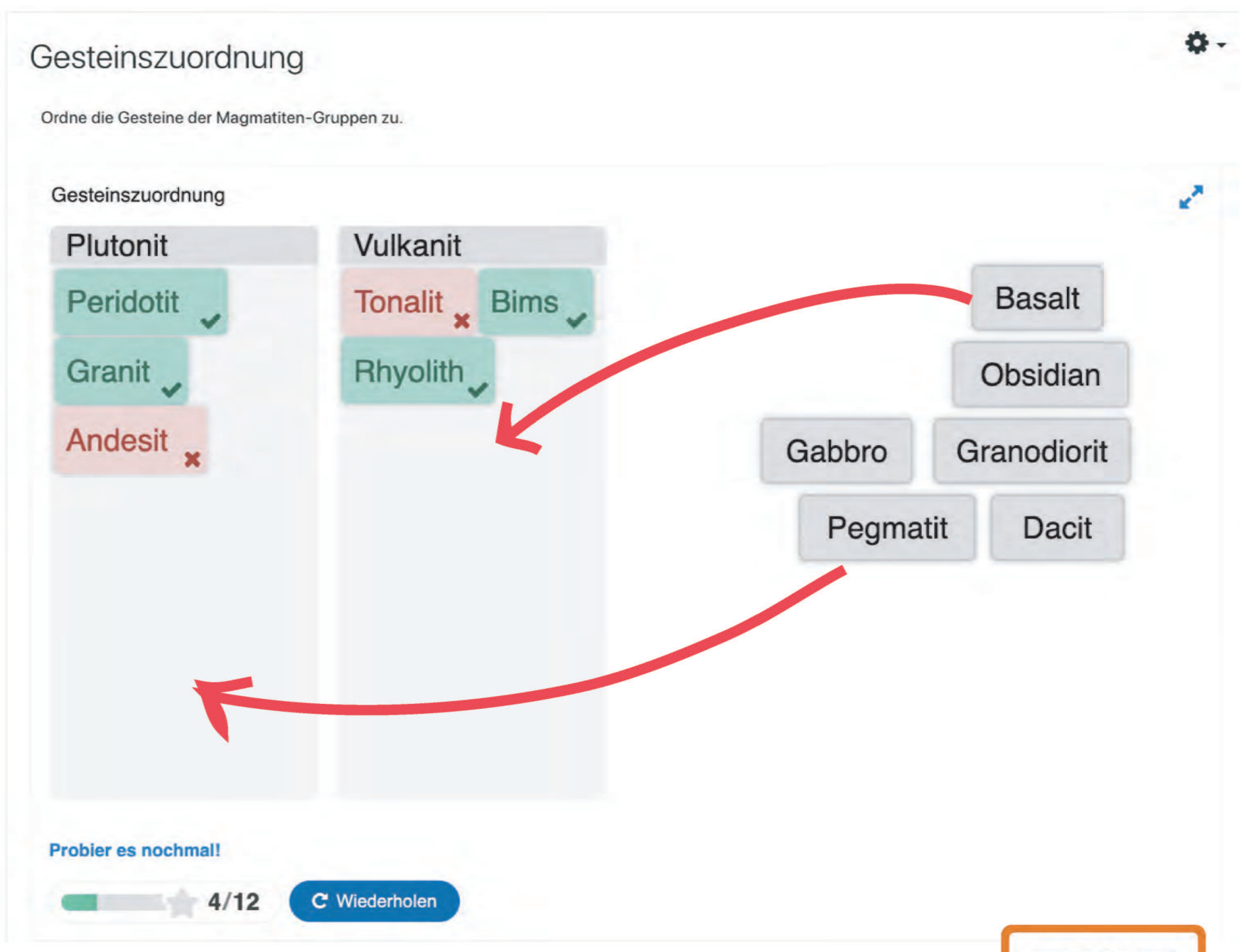
Example of drag-and-drop game in the Moodle-based rock practice lab



Gesteinszuordnung

Ordne die Gesteine der Magmatiten-Gruppen zu.

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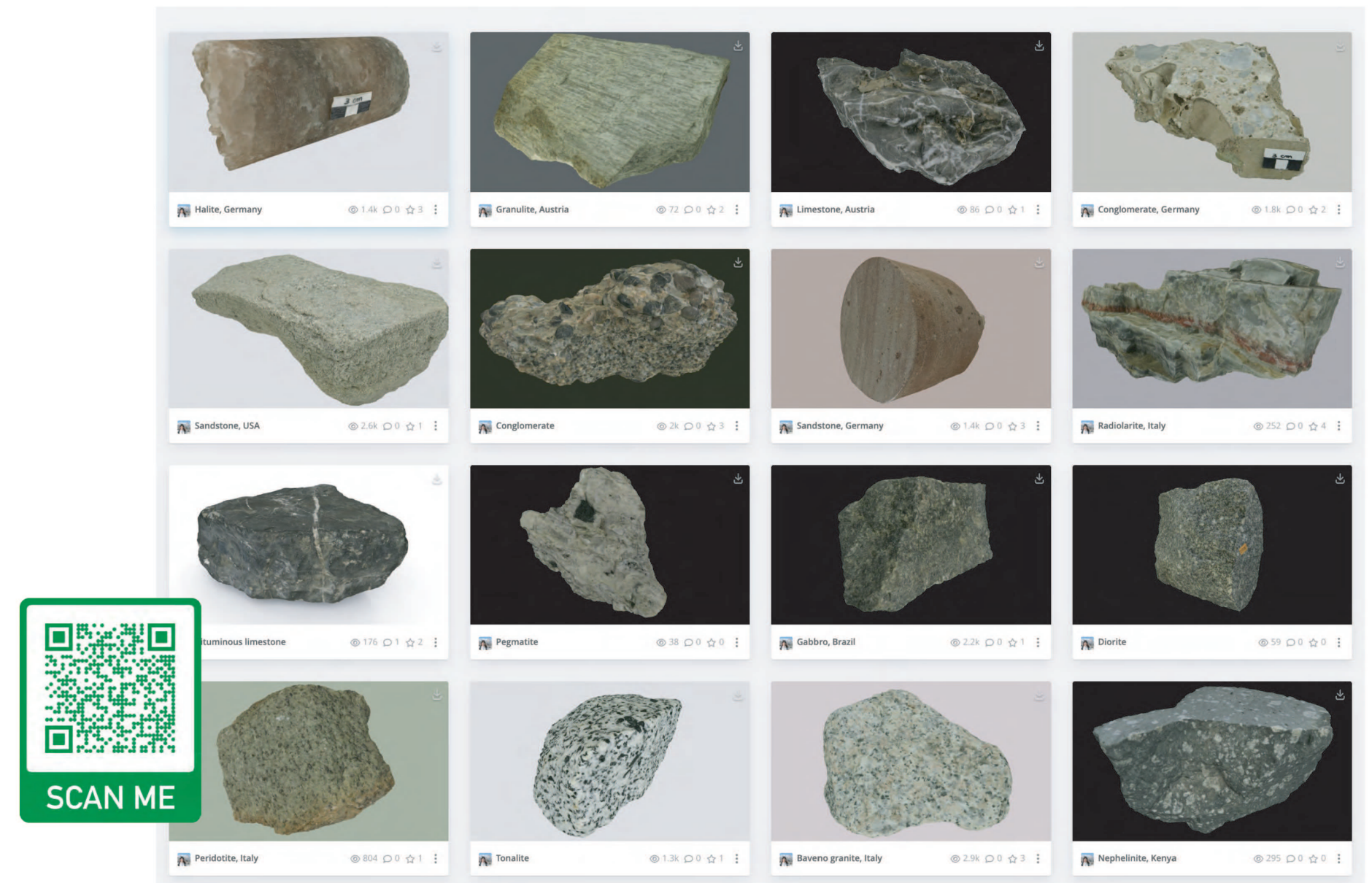
To help students learn rock names, there are several such games included in the exercise. Like for the rock descriptions, students can immediately check whether answers are correct: wrong answers turn red when the "check answers" button is pressed.

Building Virtual Field Trips from 3D Rock and Outcrop Models

Examples of 3D Rocks Stored on Sketchfab



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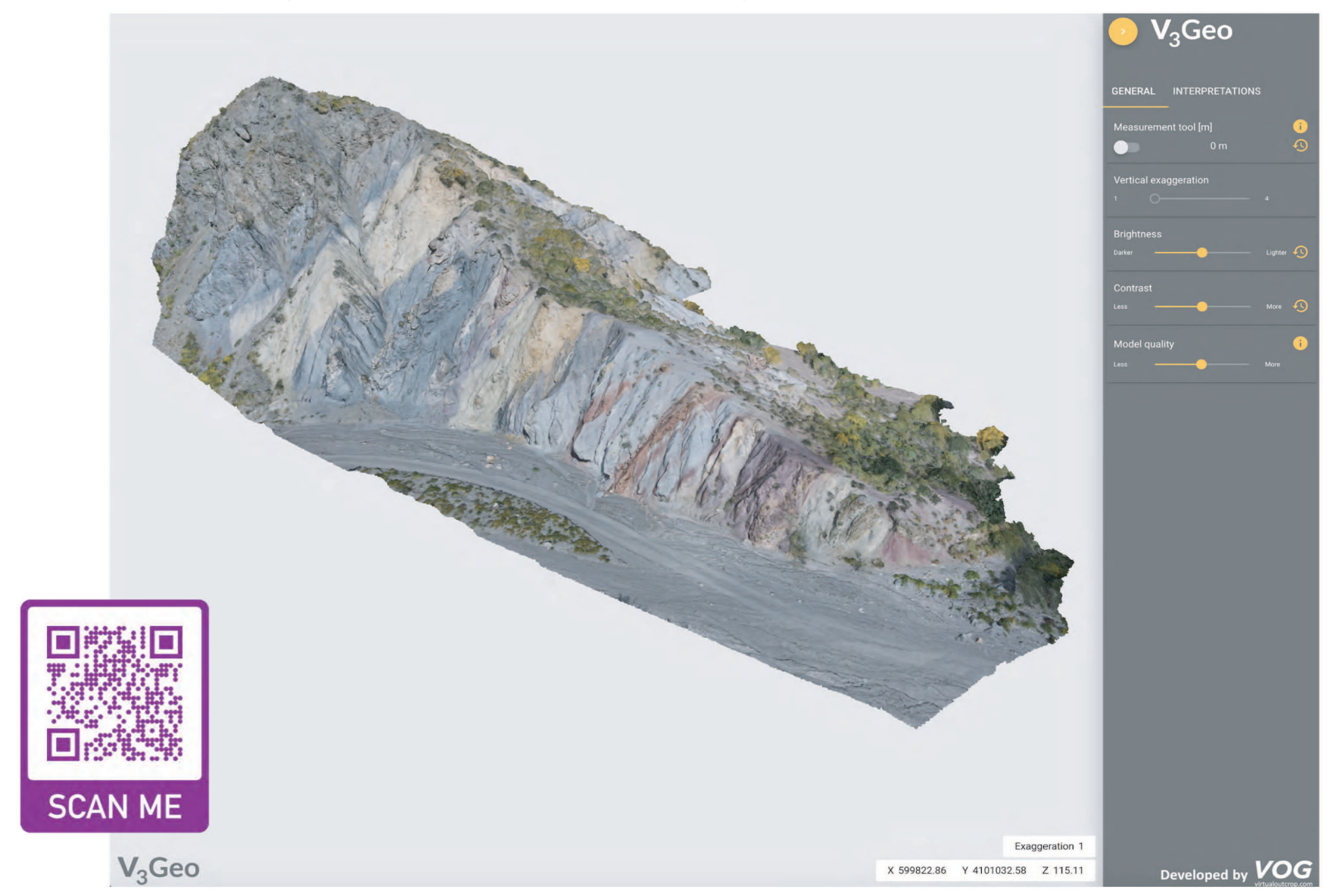
Example of 3D Outcrop Stored on V3Geo



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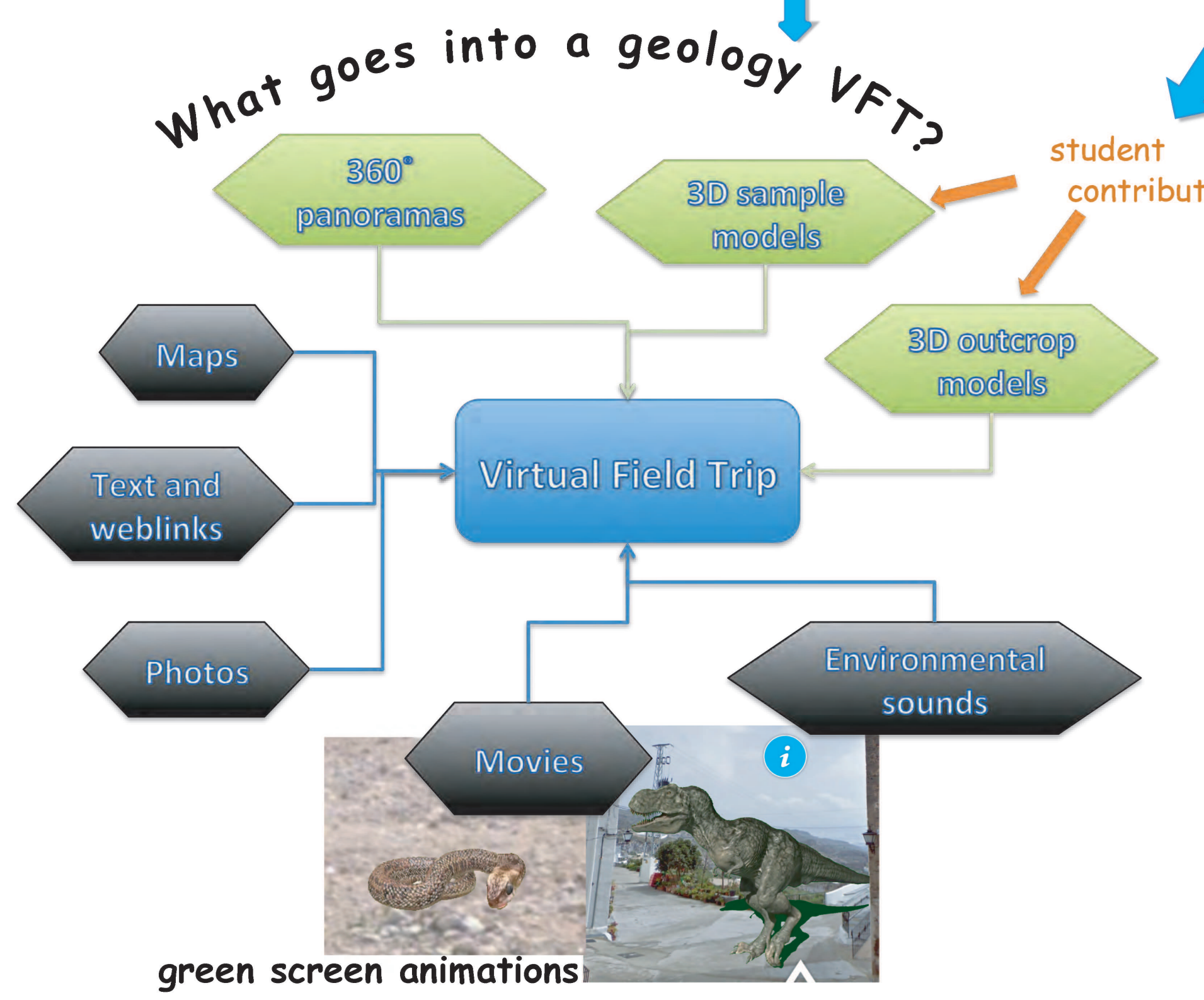
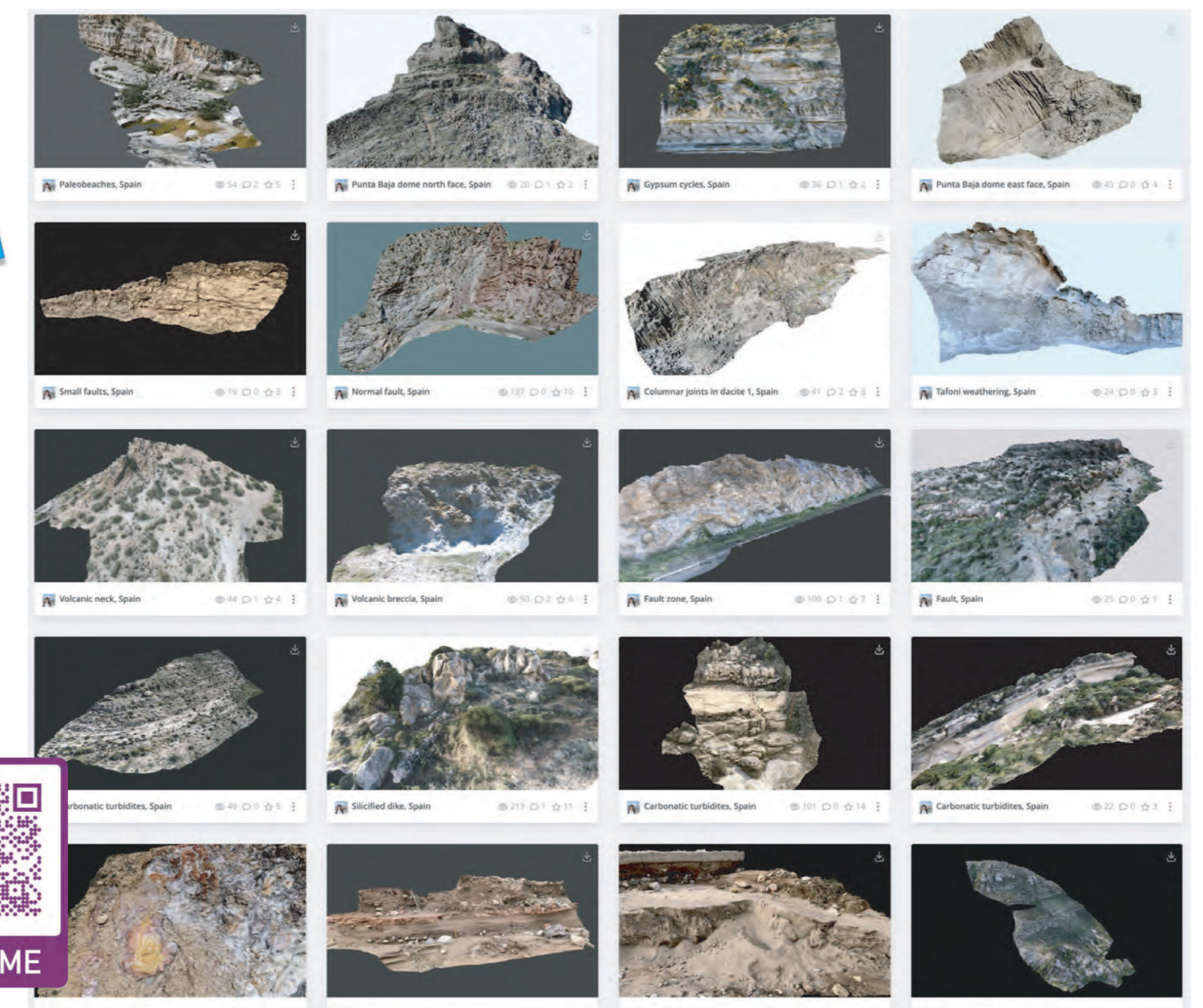
In this platform, simple distance measurements can be carried out, and the outcrop preserves georeferencing. No model labels, and it can be slow.



Examples of 3D Outcrops Stored on Sketchfab



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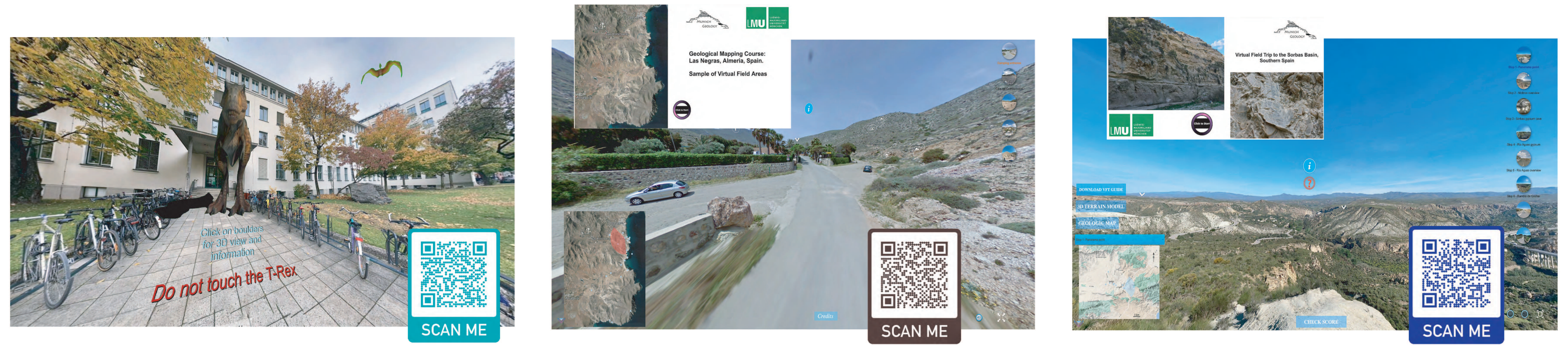
No georeferencing or measuring tools available, but this platform has very fast manipulation, and possibility to attach labels, photos, comments, or to cross-link models.

Examples of Virtual Field Trips Stored on 3DVista Cloud Server



The web-based version of VFTs shows up in the browser's default language, if translation files are supplied. Its SCORM package can be integrated into Moodle, allowing saving of scores, and the VFTs can be optimized for mobile devices, or embedded in a webpage (e.g. the "T-Rex courtyard tour" at left). The same VFTs can also be distributed to users as standalone apps (Windows or Mac) to be run on a computer: no language switching is available in this form, but it is better for people who have outdated browsers or limited bandwidth.