



GeoMate

2026 · Exploration Data Platform

ANALYSIS

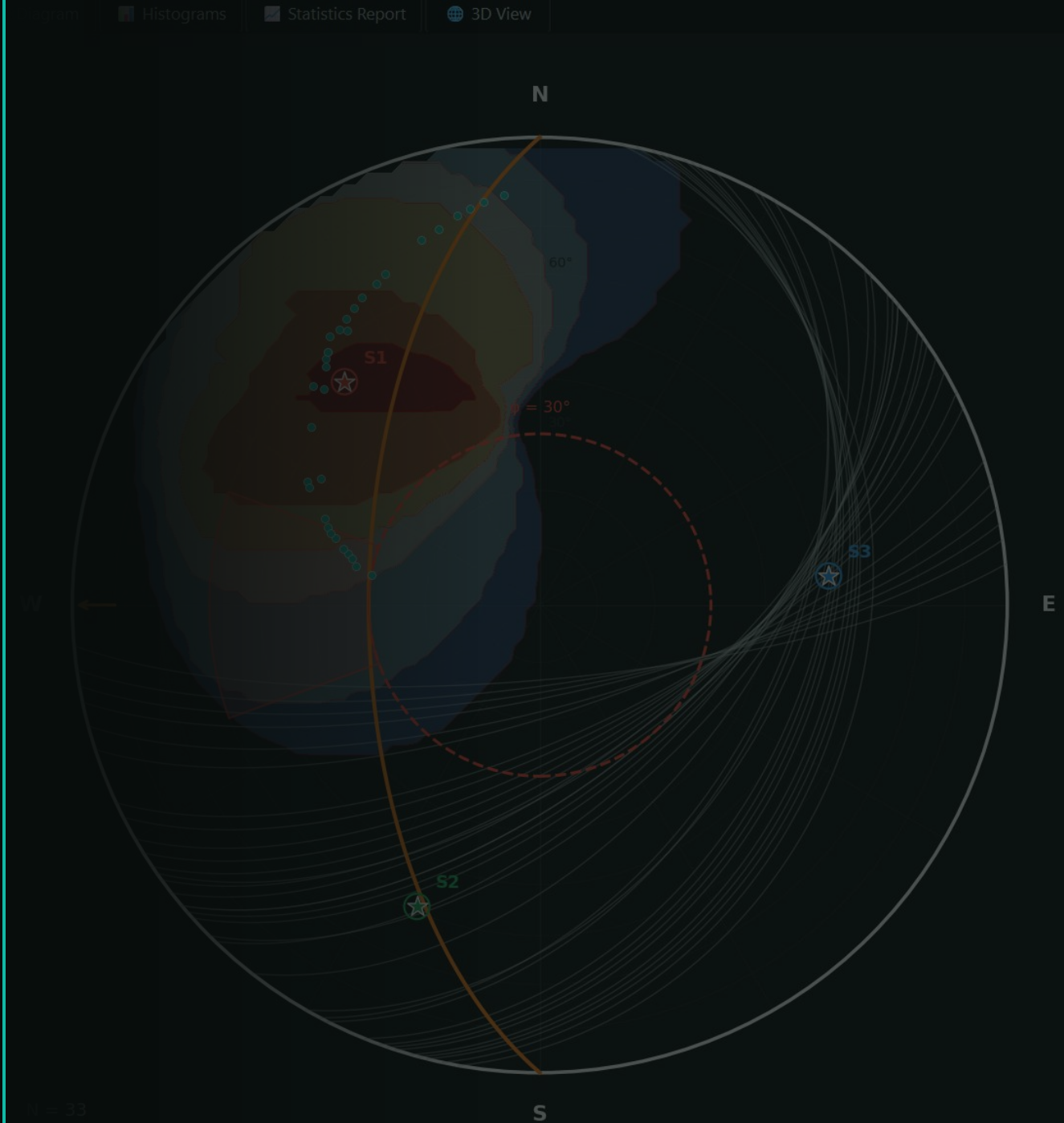
MODULE 08

Structural Analysis

Interactive Schmidt stereonet, pole density, k-means structural sets, eigenanalysis and kinematic failure analysis — on oriented logging data.

- Group: Analysis
- PNG · SVG · CSV export
- 5 tabs · equal-area or equal-angle projection
- Automatic alpha / beta restoration

Module presentation document · GeoMate 2026 · internal use · 08-stereonet · v2026.3.1.5



Executive summary

Structural Analysis reads orientation measurements straight from the database and renders an interactive Schmidt stereonet: poles, great circles, density contours, Fisher mean plane and 95 % confidence cone — with alpha/beta restoration of core-angle measurements.

01 What it replaces

The stereonet drawn in a third-party package from a manual export, and alpha/beta restoration done on a calculator.

02 How it works

The page reads the measurement table, you map dip and dip direction — or alpha and beta — filter by hole, depth, lithology or structure type, and plot. The Fisher statistics follow.

03 Who it is for

The structural geologist and the model owner: this is where the orientation of the controls on mineralisation is read.

568

structural measurements in the real dataset

072°

measured mean strike

0,635

resultant vector length (R)

3

orientation formats accepted

Statistics computed on the 568 structural measurements of the KOUKOUDAN dataset.

Contents

01 What the module does

Turn orientation measurements into structural interpretation.

02 Input formats

Dip / dip direction, right-hand-rule strike / dip, core alpha / beta.

03 Stereonet display

Poles, great circles, density contours, mean plane, reference grid.

04 Fisher statistics

Mean vector, concentration k , resultant length, 95 % cone.

05 Sets and eigenanalysis

K-means detection and $S1$ / $S2$ / $S3$ eigenaxes.

06 Kinematic analysis

Planar, wedge or toppling failure, with friction angle.

07 Anonymised data

568 measurements at N'chira: mean strike 072° , mean dip 72° .

08 Business value

Structure steers the next hole and slope stability.



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SECTION I

The module

The problem addressed, the capabilities delivered, the processing chain and the module's place in the platform.

-
- 01 Context
 - 02 Key capabilities
 - 03 Processing chain
 - 04 Place in the platform
-

Context

An orientation measured on core only means something once it is restored into the geographic frame, and a population of measurements only means something once it is contoured.

The module does both, then goes further: it detects the sets, computes the eigenaxes and evaluates failure risk for a given slope.

Alpha / beta restoration

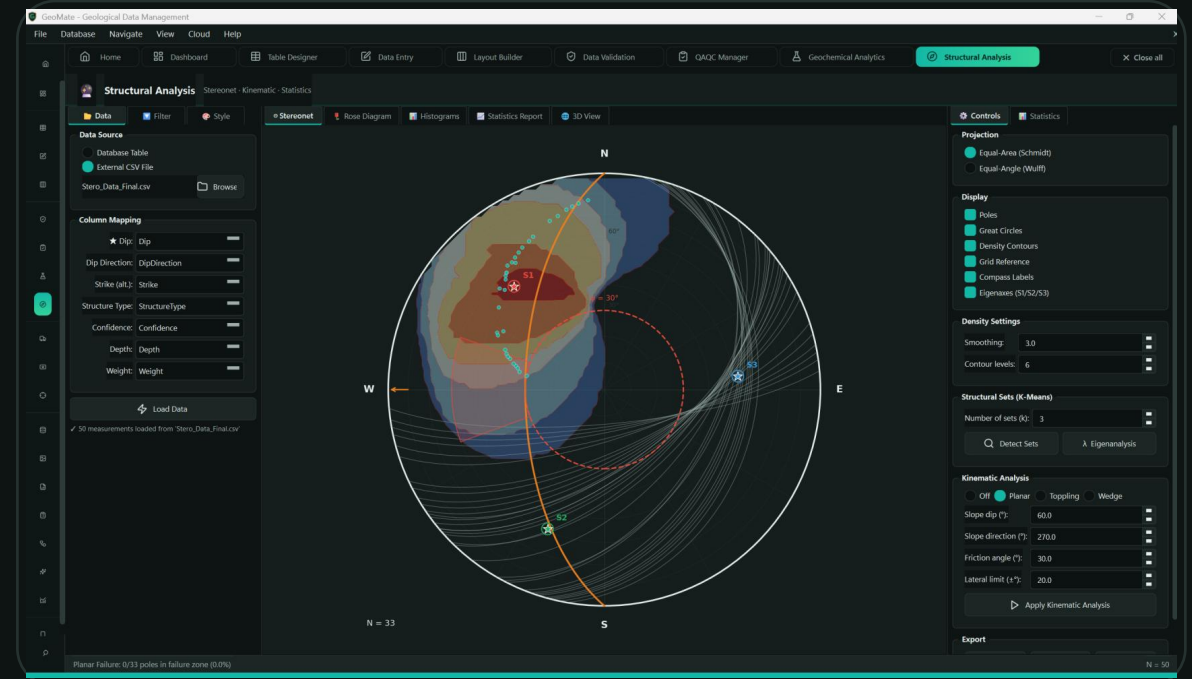
On oriented core, the Bingham algorithm is applied automatically from the hole's downhole survey.

Sets detected, not guessed

A k-means classification proposes the structural sets; eigenanalysis gives their S1, S2 and S3 axes.

Slope kinematics built in

Slope dip and direction, friction angle and lateral limit produce the percentage of poles in the failure zone.



A minimum of five measurements is required for the mean plane and the statistics; fifteen are recommended for reliable contouring.

Key capabilities



01

Equal-area stereonet

Schmidt lower-hemisphere projection, or Wulff equal-angle, with grid, primitive circle and cardinal labels.



02

Poles and great circles

Poles to planes or full traces, size and colour by structure type, lithology or drillhole.



03

Density contours

Kamb or Fisher contouring, adjustable smoothing and level count, to identify the dominant fabric.



04

Sets and eigenanalysis

K-means set detection, then S1 / S2 / S3 eigenaxes drawn on the canvas.



05

Kinematic analysis

Planar, wedge or toppling failure, with slope dip, direction, friction angle and lateral limit.



06

Rose and histograms

Strike rose diagram, dip histograms, statistics report and a 3D view of the structures.

Processing chain

From the core measurement to an interpretable geographic orientation.

A Inputs

Orientation measurements

- Dip / dip direction — the standard field measurement
- Strike / dip, right-hand rule
- Alpha / beta — angles measured on oriented core
- Downhole survey: azimuth and dip at each station
- Structure type, lithology, hole and depth

B Processing

Projection and directional statistics

- Bingham restoration of the alpha / beta angles
- Schmidt equal-area projection, lower hemisphere
- Kamb or Fisher density contours
- Fisher mean plane, concentration k and α_{95} cone
- Strike rose in 10° sectors

C Outputs

Figure and restored data

- Stereonet as a 300 dpi PNG, transparent background available
- Vector SVG for publication
- CSV of the filtered set with the restored orientations
- Direct copy to the clipboard
- Fisher statistics for the report text

DATA REQUIREMENT

A minimum of five measurements before the mean plane and the statistics are computed; fifteen or more for reliable contouring. Below that, the figure exists but the interpretation has nothing to stand on.

Alpha/beta restoration assumes oriented core and loaded survey data: without them the restored orientation is wrong without being flagged as such.

Place in the platform

FED BY

03 Data Entry

Supplies the measurement table: alpha, beta or dip and dip direction, by interval.

05 Data Validation

Checks out-of-range alpha, beta, dip and direction values, and ambiguous directions.

13 Core Image Manager

Lets a doubtful measurement be retaken on the photograph rather than on the core.



Structural Analysis

The structural reading: it converts angles measured in core into statistically characterised geographic orientations.

FEEDS

17 Geological Intelligence

The fabric orientation gives the anisotropy of the variography and the estimation.

14 Report Builder

Stereonet and rose go straight into the structural chapter.

— Drilling programme

A hole intersecting the fabric at a low angle samples it badly: orientation decides.



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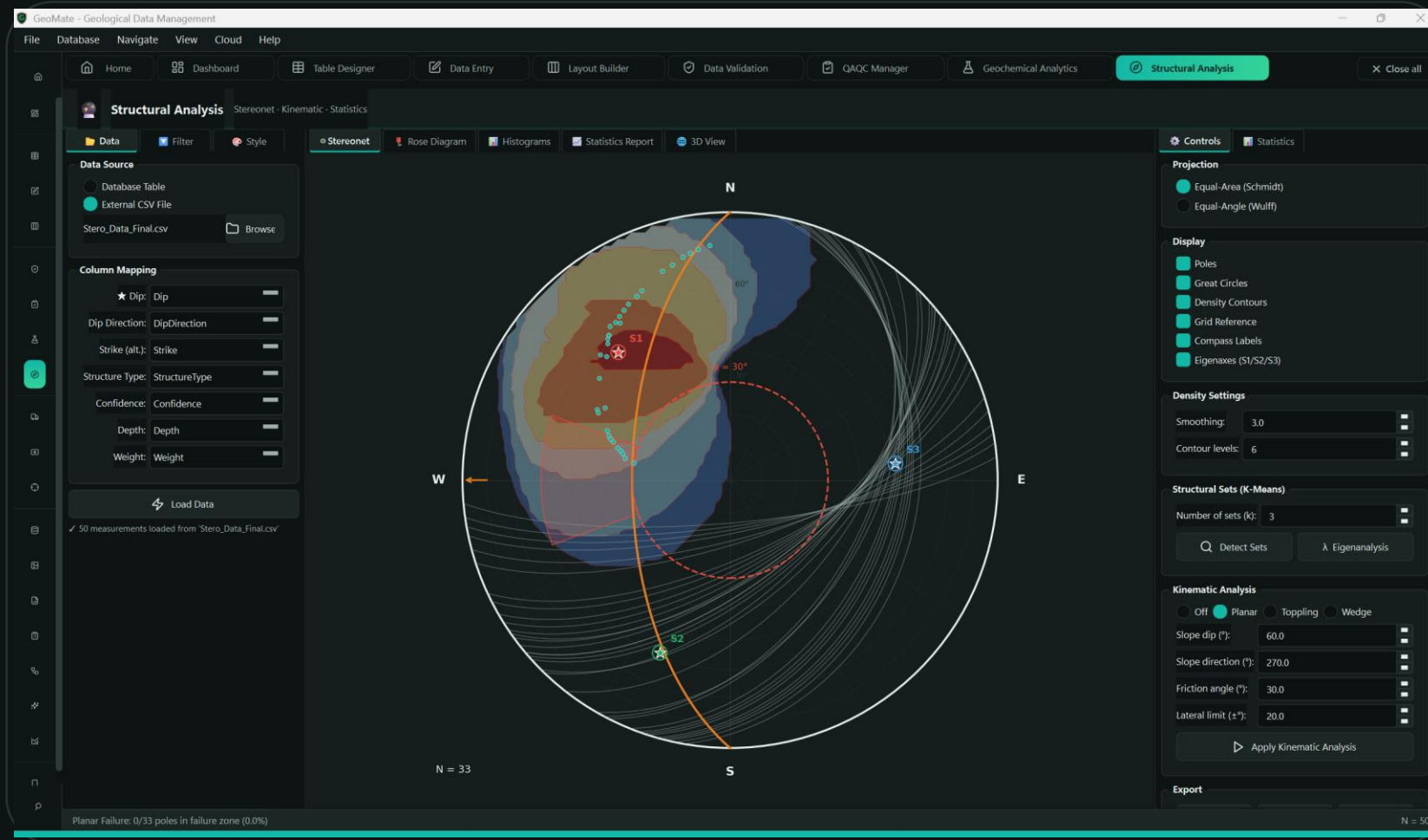
SECTION II

In practice

The real interface, the operating workflow, the reference settings, good practice and the questions that come up.

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- 01 The interface
 - 02 Operating workflow
 - 03 In depth
 - 04 Good practice
 - 05 Frequently asked
-

The interface



1 Source and mapping

Database table or CSV; dip, dip direction, strike, type, confidence, depth, weight.

2 Five tabs

Stereonet, rose diagram, histograms, statistics report and 3D view.

3 Interactive canvas

Poles, density contours, great circles and S1 / S2 / S3 eigenaxes.

4 Display controls

Projection, poles, great circles, contours, grid, labels, eigenaxes.

5 Kinematics

Slope 60°, direction 270°, friction 30°, $\pm 20^\circ$ limit — 0 poles out of 33 in the failure zone.

Actual GeoMate 2026 v2026.3.1.5 screen capture — Midnight theme.

Operating workflow

Six steps, from the orientation table to the publication figure.

1

Load

Database table or external CSV holding the orientation measurements.

2

Map

Dip and dip direction, or alpha and beta; type, confidence, depth.

3

Filter

Restrict to a hole, an interval, a lithology code or a structure type.

4

Plot

Poles, great circles and contours; the Fisher statistics appear at once.

5

Interpret

K-means sets, eigenanalysis, then kinematics for the slope in question.

6

Export

300 dpi PNG, vector SVG for publication, or CSV of the restored orientations.

Accepted orientation formats

FORMAT	REQUIRED COLUMNS	NOTE
Dip / dip direction	Dip, DipDir	Standard field measurement — dip 0-90°, dip direction 0-360°
Strike / dip (RHR)	Strike, Dip	Right-hand rule: strike + 90° gives the dip direction
Alpha / beta	Alpha, Beta	Requires oriented core and the downhole survey; the Bingham restoration is applied automatically

The statistics panel

QUANTITY	MEANING	N'CHIRA REAL SET
N	Number of measurements plotted	568
Mean strike	Fisher mean vector, axial over 0-180°	072°
Mean dip	Dip of the mean vector	72°
Resultant length R	0 = uniform, 1 = perfectly clustered	0.635
Concentration k	Fisher parameter — the higher, the tighter	At run time
α_{95} cone	Half-angle of the 95 % confidence cone around the mean	At run time

Anonymised dataset: 568 structural measurements logged on the N'chira prospect — 387 foliations, 127 quartz veins, 27 fractures, 22 shear zones, on schists, amphibolites and gabbros.

Good practice

The checks before interpreting a stereonet.

✓ Identify the input format

Dip/dip direction, RHR strike/dip or alpha/beta: confusing them rotates the whole set by 90°.

✓ Load the survey before restoring

Alpha/beta restoration uses the hole's azimuth and dip at the measurement depth. Without them it has no frame.

✓ Separate the structure types

Foliation, quartz vein, fracture and shear do not mean the same thing: contouring them together mixes two fabrics.

✓ Check N before concluding

Five measurements suffice for a mean plane, fifteen for contouring. A density maximum on eight points is not a fabric.

✓ Read R and k, not just the mean

A mean direction with no dispersion measure says nothing: R close to 0 means a near-uniform distribution.

✓ Account for sampling bias

A hole under-samples the structures parallel to it. Without correction the dominant fabric can be an artefact of the drilling direction.

Frequently asked

What comes up in front of a stereonet.

Q Why is no mean plane shown?

At least five measurements are needed in the current selection. The filters may have cut the set below that.

Q Kamb or Fisher for contouring?

Kamb normalises against a uniform distribution and flags what departs from it significantly; Fisher smooths under a directional law. Kamb is the usual exploration choice.

Q What does α_{95} mean?

The half-angle of the cone containing the true mean direction with 95 % confidence. Small, and the mean is well constrained.

Q Can I colour by lithology?

Yes: poles colour by structure type, by lithology or by hole — which is what reveals that a maximum comes from a single hole.

Q Which projection is used?

Schmidt equal-area, lower hemisphere — the standard in structural geology because it does not distort densities.

Q How do I get a publishable figure?

SVG export for scalability, or a 300 dpi PNG with transparent background to sit over a basemap.



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SECTION III

The data

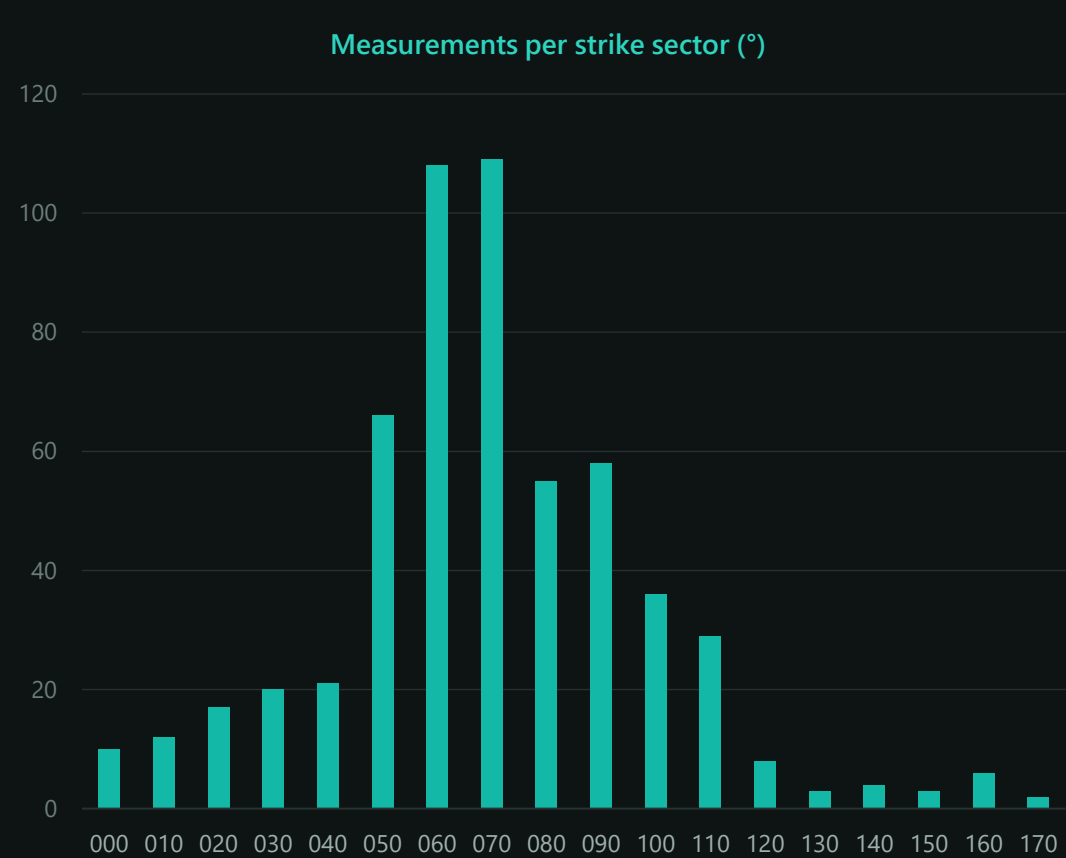
What the module produces on a real dataset, and the vocabulary needed to read those results.

01 Anonymised data

02 Key concepts

Anonymised data

Real strike rose of the 567 oriented measurements from the N'chira prospect, in 10° sectors.



STRUCTURE TYPE	COUNT
Foliation	387
Quartz vein	127
Fracture	27
Shear	22
Decrochement dextre	1
Aplite dyke	1
TOTAL	568
Mean strike	072°
Mean dip	72°
Resultant R	0.635

Mean strike 072°, resultant 0.635: a clearly organised ENE fabric, consistent with a shear corridor. Source: KOUKOUDAN project database (Senegal) — figures computed from the real data exported from GeoMate.

Key concepts

The vocabulary of directional statistics.

Schmidt stereonet

An equal-area projection of the lower hemisphere: pole densities are comparable from one point of the net to another.

Alpha / beta

The two angles measured on core: alpha against the core axis, beta around it from the reference line.

Concentration k

The Fisher parameter: the higher it is, the tighter the measurements sit around the mean direction.

Pole

The normal to the measured plane, drawn as a point. A set of parallel planes forms a tight cluster of poles.

Restoration

The computation converting alpha and beta into geographic dip and dip direction, from the hole's orientation at that depth.

Resultant length R

The norm of the resultant vector, normalised between 0 and 1. Zero: uniform distribution. One: every measurement identical.



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SECTION IV

Value & specifications

What the module changes for the project, and its technical integration profile.

-
- 01 Business value
 - 02 Technical profile
-

Business value

Core orientation becomes usable

Alpha / beta restoration by the Bingham algorithm turns a local measurement into usable geographic data.

Auto restoration

The sets come out of the data

K-means and eigenanalysis replace eyeballing the stereonet.

Adjustable k

Slope stability is quantified

The percentage of poles in the failure zone, for a given slope and friction angle, is a number, not an impression.

Kinematics

The figure is publication-ready

Vector SVG export, losslessly scalable for a technical report or a paper.

Vector SVG

The next hole is oriented

Knowing the dominant strike and dip avoids drilling parallel to the structure — the most expensive mistake of a campaign.

Targeting

Technical profile

Projection & plotting

Projections

Schmidt equal-area, Wulff equal-angle

Hemisphere

Lower

Contouring

Kamb or Fisher, adjustable smoothing and levels

Symbols

Size 2 to 12 px, colour by attribute

Statistics

Mean

Fisher vector, mean plane

Dispersion

Concentration k, resultant R, α_{95} cone

Sets

K-means, configurable set count

Eigenaxes

S1, S2, S3 drawn on the canvas

Outputs

Image

300 dpi PNG, optional transparent background

Vector

SVG for publication

Data

CSV of the filtered set with restored orientations

Clipboard

Direct copy of the current image



One platform, from field to report

The “Structural Analysis” module is one of the 19 modules of GeoMate 2026 — a single, fully offline platform covering the whole chain: database design, data entry, validation, QA/QC, dispatch, analysis and reporting.