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An integrated system for macro-scale anhydrite classification

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Most anhydrite classification systems to date have focused primarily on the naming of anhydrite bodies, masses, or crystals themselves rather than focusing on both the mineral morphology and links to the sedimentary succession in which it occurs. Much of the reasoning for the lack of development of an integrated classification system for anhydrite may come from the inherent instability of the mineral, and therefore the difficulty making a link between any particular morphology and a specific formative process or environment. This sets anhydrite classification apart from other sedimentary classification schemes, as most of them (e.g., Dunham, McBride, *etc*.) naturally break into groups that can be related to sorting, textural maturity, mode of deposition, or other genetic process. A classification system for anhydrite has been developed that allows for information about the gross anhydrite volume and morphology, as well as host sediment type to be transmitted using a single type-name. This new integrated anhydrite classification scheme was developed using input from both previously developed schemes and field studies with a view to link anhydrite morphology and volume to precursor depositional process. These relationships have been shown to hold true in certain circumstances, with both gross anhydrite volume and morphology many times being characteristics that are particular to former depositional setting (bedded, laminated salinic anhydrite *versus* nodular sabkha anhydrite, as an example). By adding a host rock descriptor to the scheme, quite a bit of empirical information about the anhydrite-bearing rock is made available in a single name, which can then be more easily linked to genetic process. Such a scheme may have wide application in industry, where careful description and classification of anhydrite is a key component to understanding the distribution of reservoir rock types in the subsurface.

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OVERVIEW AND BACKGROUND

The impetus behind this work was to develop a user-friendly macro-scale classification system for anhydrite that allows for information about the gross anhydrite volume and morphology, as well as host sediment type to be transmitted using a single type-name. Most anhydrite classification systems to date have focused primarily on the morphology of the anhydrite bodies/masses or crystals themselves (e.g., Maiklem *et al*., 1969; Meyer, 2005) rather than focusing on both the mineral morphology and wider links to the sedimentary succession in which it occurs. That said, this scheme is not meant to be a substitute for the interpretive process (which ought to also include analysis of the entire sedimentary succession and facies therein), but rather aims to be a step in bridging the gap between classifying anhydrite and determining depositional process that may have been related to its formation.

There are many publications within geological literature that deal with sediments that bear, or are dominantly composed of evaporite minerals. Of those, comparatively few focus specifically on sulfate minerals, and even fewer specifically on anhydrite. Of that body of literature, only a few utilize a classification scheme for anhydrite, the dominant, if not near-universal phase of calcium sulfate found in the subsurface (Murray, 1964; Maiklem *et al*., 1969; Meyer, 2005). Indeed, only one of these (Maiklem *et al*., 1969) has been referenced through usage in another study (Loucks and Longman, 1981), though the applicability was limited.

Much of the reasoning for the lack of development of a classification system for anhydrite may come from the inherent instability of the mineral, resulting in difficulty making a link between any particular morphology and a specific formative process or environment. As a result classification schemes thus far have focused on giving names to crystal shapes and morphologies, while the link between morphology and process has remained comparably difficult to construct a scheme around. However, studies such as those by Warren and Kendall (1985) and Kasprzyk (2003) have made progress in linking anhydrite facies associations to depositional process. As important as these findings have been, they did not link their environmental/formative process interpretations to a specific classification scheme for anhydrite morphology. Of course, this is likely due to the necessity for keeping observations and interpretations separate in any classification scheme. However, it can be shown that careful arrangement of classification groups can yield a system that allows for easier linkage to depositional process than is found in current schemes. In short, the pieces exist for a classification scheme to be developed for anhydrite that relates to process, but the loop has yet to be closed.

Below is a brief review of specific studies related to anhydrite classification, and a review of the literature linking anhydrite facies associations and depositional environments. Following this summary, a new macro-scale anhydrite classification system is presented based around important portions of all the studies considered here. Again, the intention is to generate a classification system that may more easily relate a descriptive-based scheme for macro-scale anhydrite types to lithology and depositional setting.

PREVIOUS STUDIES: ANHYDRITE CLASSIFICATION

Murray (1964) identified three categories of anhydrite that have morphologies that reflect the mode of formation. They are: (1) bedded anhydrite, (2) pore-filling anhydrite and (3) replacement anhydrite.

1. **Bedded anhydrite**. Most anhydrite observed in the subsurface is metagypsum. This gypsum would have originally formed through evaporation of concentrated brine and deposited either as: a – sedimentary laminae, representing primary deposition from a standing body of water, or, b – displacive or compacted nodular fabrics within host sediment.

2. **Pore-filling anhydrite**. Pore filling anhydrite occurs in previously existing void space within rock. Anhydrite precipitated in existing pore spaces will rarely include relict fragments of pre-existing rock and will therefore usually form clear individual or clustered crystals. Murray (1964) notes, however, that pore-filling anhydrite often continues to grow into the rock mass and therefore commonly co-occurs with replacement anhydrite.

3. **Replacement anhydrite**. Replacement anhydrite grows within space previously occupied by host rock. Inclusions of the replaced calcite, dolomite, or clastic material are commonly found within replacement anhydrite and can easily be seen in plain light or when the crystal is turned to extinction.

Maiklem *et al.* (1969) are the first to publish a classification scheme for anhydrite intended to be cross applicable to basins globally. Their scheme is based on two basic descriptive properties of the anhydrite being considered:

1. The structure of the anhydrite (external form, anhydrite-to-matrix relationship, bedding and distortion).
2. The texture of the anhydrite (size, shape and spatial relationship of anhydrite crystals within the anhydrite mass).

The first thing Maiklem *et al.* (1969) consider in their scheme is anhydrite structure- the shape and spatial relationship of the anhydrite masses within the rock. Anhydrite structural types are subdivided by considering four parameters:

1. External form: (a) crystal shaped – the external form of the anhydrite is determined by crystal faces, or (b) not crystal shaped – the form of the anhydrite mass is irregular.
2. Anhydrite-to-matrix relationship: anhydrites with crystal shaped forms are typically completely separated by matrix. Anhydrite with not-crystal-shaped forms are subdivided into three groups may or may not be separated by matrix.
3. Bedding: bedded types are separated from non-bedded types.
4. Distortion: distortion is quite common in anhydrite masses are subdivided relative to the degree and nature of the distortion.

Maiklem *et al.* (1969) then consider anhydrite textural types, which are classified by 1 – crystal shape, 2 – crystal size, and 3 – crystal texture. By considering the anhydrite structure and texture, the user then arrives at a name for the anhydrite type. This classification is summarized on a chart included in Maiklem *et al.* (1969).

Meyer (2001) focuses on the diagenesis of $CaSO_4$, taking special care to define the role gypsum and anhydrite play in the creation and destruction of porosity. He notes that there is a paradox concerning the precipitation of $CaSO_4$ and its occurrence as either gypsum or anhydrite (Meyer, 2001). Experimental and theoretical data indicate that both gypsum and anhydrite ought to precipitate from saturated brines at standard temperature and pressure conditions. However, it is widely observed that gypsum is nearly always the calcium sulfate mineral precipitated at earth surface conditions while anhydrite dominates the record in the subsurface.

In modern sabkha environments, nodular anhydrite is almost exclusively found in supratidal settings. Proceeding landward from the intertidal zone, $CaSO_4$ occurrence is typically as gypsum mush, followed by gypsum nodules, and finally anhydrite nodules landward of the spring high tide mark. While there is some intermixing, the abundance of anhydrite is typically quite low with small crystals forming (<1.25 mm) in the intertidal zone. Outside of this distribution, it was also noted that the occurrence of anhydrite nodules is above the ground water table, which is consistent with observations made at the Dukhan sabkha, Qatar (Fig. 1). In any case, the volume of primary anhydrite within this depositional system is low as compared to gypsum.

Both gypsum and anhydrite cements are also described by Meyer (2001). Gypsum cements typically occur as large, clear, euhedral crystals or subeuhedral aggregates within sands. Crystals typically precipitate on a grain and grow into and fill void space. Anhydrite cements may form clear, euhedral to subeuhedral crystals with well-developed cleavage in two directions. Where crystal growth is able to continue into adjoining pore space poikilotopic texture may develop. Anhydrite cements typically lack a pore-lining distribution and possess marked crystal size differences. Anhydrite cementation is usually regarded as a late porosity-plugging event that relies on primary gypsum as a source.

Fig. 1. Nodular anhydrite masses forming within a few centimetres of the surface in the Dukhan sabkha, Qatar

The anhydrite (white) appears to be confined to a layer *ca*. 20 cm from the surface. Gypsum crystals also grow interstitially deeper within the sediment column, particularly where the sediment is damp. When the water table was encountered (*ca*. 0.5 m from the surface), larger cm-scale gypsum crystals were identified

Through continued research, Meyer (2005) developed a classification system for anhydrite that is available through the carbonate research consulting (CRC) group website. This system is again primarily a shape-name system though Meyer (2005) does indicate that the system is a work in progress and that future revisions may be applied.

THE RELATIONSHIP BETWEEN ANHYDRITE FACIES ASSOCIATIONS AND DEPOSITIONAL ENVIRONMENT

Descriptive schemes are many times most useful if they include more than a simple name for a given morphology, but also are able to relate additional information about the item in question to the user. In the case of sedimentological classification schemes, including information relating to texture, sorting, mode of deposition, and morphology make classification schemes more useful than simply giving a name to a shape.

Limited encompassing work has been done specifically to link gypsum and anhydrite types to primary depositional environment. Again, this is most likely because of the propensity of these minerals to dissolve, neomorphose, and/or precipitate as a later phase after the deposition of host sediment. However, it can be demonstrated that in certain instances $CaSO_4$ facies associations can be diagnostic of primary depositional environments. Two publications that deal with this topic specifically are: Warren and Kendall (1985) and Kasprzyk (2003).

Warren and Kendall (1985) identify key diagnostic criteria for separating evaporite sequences formed in sabkha (subaerial) *versus* salina (subaqueous) environments by comparing modern deposits with ancient analogs. They begin by characterizing the sulfates in sabkha deposits. In general, sabkha deposits occur as part of a laterally-prograding, shoaling-upward peritidal sequence with each individual shoaling-upward sequence being roughly metre-scale. In this case, sulfates occur in a matrix-dominated lithofacies, with the bulk of the evaporite phases occurring as nodules, enteroliths (concretions), and diapir-like structures. Facies groups in sabkhas tend to occur in belts parallel to shoreline. Relative to sea level or brine level, these deposits tend to occur on palaeogeographic highs. Salinas deposits, on the other hand, tend to occur as shoaling-upward deposits, typically several metres to 10 of metres thick. The lithofacies are evaporite-dominated, with the bulk of evaporite phases occurring as either bottom-nucleated crystals, massive $CaSO_4$ units, laminated beds (particularly in lakes), and rippled beds. In plan view, salina facies tend to occur in a bulls eye pattern, with a sulfate and evaporite-dominated center and a carbonate-dominated rim. Relative to sea level or brine level, these deposits tend to occur on palaeogeographic lows. One of the fundamental differences between the evaporites occurring in these subenvironments is the net volume in which they occur at the metre-scale.

Kasprzyk (2003) focused directly on identifying the relationship between gypsum and anhydrite facies and depositional environment. Detailed studies of sulfate-dominated sections and wells allowed for reconstruction of different palaeogeographic settings and palaeoenvironments across the evaporite basin, thereby allowing links between evaporite type and depositional environment to be identified. She groups sulfate lithofacies into three associations related to the relative water depth in which they were interpreted to have formed (Kasprzyk, 2003). The first is the nearshore facies association (NA), which is related to the shoreline system and includes coastal mudflats and sabkhas. Units are characterized by gradual transitions both laterally and vertically from subaqueous to subaerial facies. Nodular and enterolithic structures within metre-scale depositional successions and show evidence of interstitial/displacive growth. Anhydrites in this association are often pseudomorphs after gypsum. The second association Kasprzyk (2003) describes is the shallow water facies association (SA), which is related to an evaporative inner platform/lagoon system. Included are deposits formed in partly restricted subaqueous platform environments. These deposits are characterized by mosaic, nodular mosaic, massive, irregular (crinkly) laminated gypsum and anhydrite. In addition, facies often have an absence of high-energy structures. Anhydrite is often pseudomorphic after bottom-nucleated vertically-oriented selenite crystals. The deep-water facies association (DA) is related to the outer platform, slope, and basinal settings. It is characterized by brecciated anhydrite with bedded, lenticular/flaser and contorted beds occupying the platform-to-basin (slope) transition. Laminated to micronodular (pearl-like) anhydrite is also common, with micronodules having formed displacively in laminated anhydrite.

In general, the most apparent diagnostic separation between anhydrite formed in sabkhas and those forming from standing evaporative waters lies within the proportion of gypsum and anhydrite *versus* host sediment at the metre-scale. Naturally, evaporite morphology, associated facies, vertical and lateral trends, and diagenetic effects need to be considered as well, but at a basic level both Warren and Kendall (1985) and Kasprzyk (2003) are able to demonstrate that the volumetric proportion of $CaSO_4$ to host sediment appears related to depositional process.

Anhydrite Group Name	*Anhydrite Fabric Name*	*Anhydrite Fabric Subgroup Name*
In a meter-scale succession of sediment, the dominant lithology is non-evaporite (e.g., carbonate or clastic): *Anhydritic Matrix*	The primary fabric is: Pore/Void Filling	Fill is: Moldic
		Fill is: Void filling (e.g., Breccia, Burrow-fill, Cement, Fracture-fill)
	The primary fabric is: Nodular	Nodules are: Solitary
		Nodules are: Coalesced
	The primary fabric is: Crystallotopic	Crystals are: In-place Pseudomorphs
		Crystals are: Disrupted Pseudomorphs
	The primary fabric is: Layered	Layers are: Stratigraphic
		Layers are: Disrupted or Diapiric
In a meter-scale succession of sediment, the dominant lithology is anhydrite: *Anhydrite*	The primary fabric is: Massive	The fabric is: Non-Distinct
		The fabric is: Pseudo-crystalline
	The primary fabric is: Mosaic	Mosaic is: Pseudo-crystalline
		Mosaic is: Pseudo-nodular
	The primary fabric is: Layered	Layers are: Stratigraphic
		Layers are: Disrupted or Diapiric

Fig. 2. Macro-scale classification scheme for anhydrite

The scheme is presented here as a flow chart, to be used while classifying by reading from left to right, with the resulting classification name given my reading back across the flow chart from right to left

MACRO-SCALE ANHYDRITE CLASSIFICATION – AN INTEGRATED APPROACH

As previously stated, one of the difficulties associated with developing a useful classification system for anhydrite relates to linking morphology to any specific or singular process. In the case of anhydrite, developing a classification scheme for anhydrite that only gives names to the morphology of anhydrite mass shapes without considering other factors (description of sedimentary succession, stratigraphy, diagenesis *etc*.) may not provide an adequate amount of information for the scheme to be terribly useful. Ideally, classification schemes ought to be based on description and observation and not interpretation. However, the hope of beginning to link formative process to anhydrite texture/structure demands that we examine facies associations to see if descriptive groupings may relate to any specific formative process. As discussed above, it can be demonstrated that anhydrite dominated successions (e.g., *ca*. 75% anhydrite in a metre-scale succession) tend to have had an origin in standing bodies of water, while successions that contain a greater volume of sediment/matrix than anhydrite tend to have formed in subaerial evaporative conditions or within the diagenetic realm (see Warren and Kendall, 1985; Kasprzyk, 2003). Later diagenetic anhydrite (e.g., replacive phases) can also add a significant volume of anhydrite to a sedimentary succession, so it must be stressed that the above relationship is not a universal truth, and require the integration of anhydrite type-recognition with broader facies and stratigraphic interpretations to be more robust. In general terms, however, it is quite often the case that successions composed of *ca*. 75% anhydrite (or more) at the metre-scale tend to have origins from standing evaporative waters. Per course, this differentiation is a natural place to split anhydrite groupings at the macro-scale: into those metre-scale successions dominated by anhydrite and those metre-scale succession that include anhydrite but are dominantly sediment/matrix by volume (clastic or carbonate). Therefore the classification system presented here starts by separating those successions that are dominantly anhydrite at the metre-scale (the "anhydrite" group) and those successions that are anhydrite-bearing but dominantly host sediment volumetrically (the "anhydritic matrix" group). The term "matrix" here refers to that sediment within which the anhydrite occurs. In practice, the term matrix can be replaced with the textural description (e.g., Dunham name in the case of carbonates) of the host sediment. A flow chart of this classification system is included here as Figure 2.

ANHYDRITE GROUP

Within metre-scale successions where anhydrite is the dominant lithology, Maiklem *et al.* (1969), Warren and Kendall (1985) and Kasprzyk (2003) all highlight three general morphological groups that can be distinguished. These groups are here considered classification subgroups of the larger anhydrite group. Examples of these types of anhydrite can be seen in Figure 3. The first is the massive morphology, which is defined as

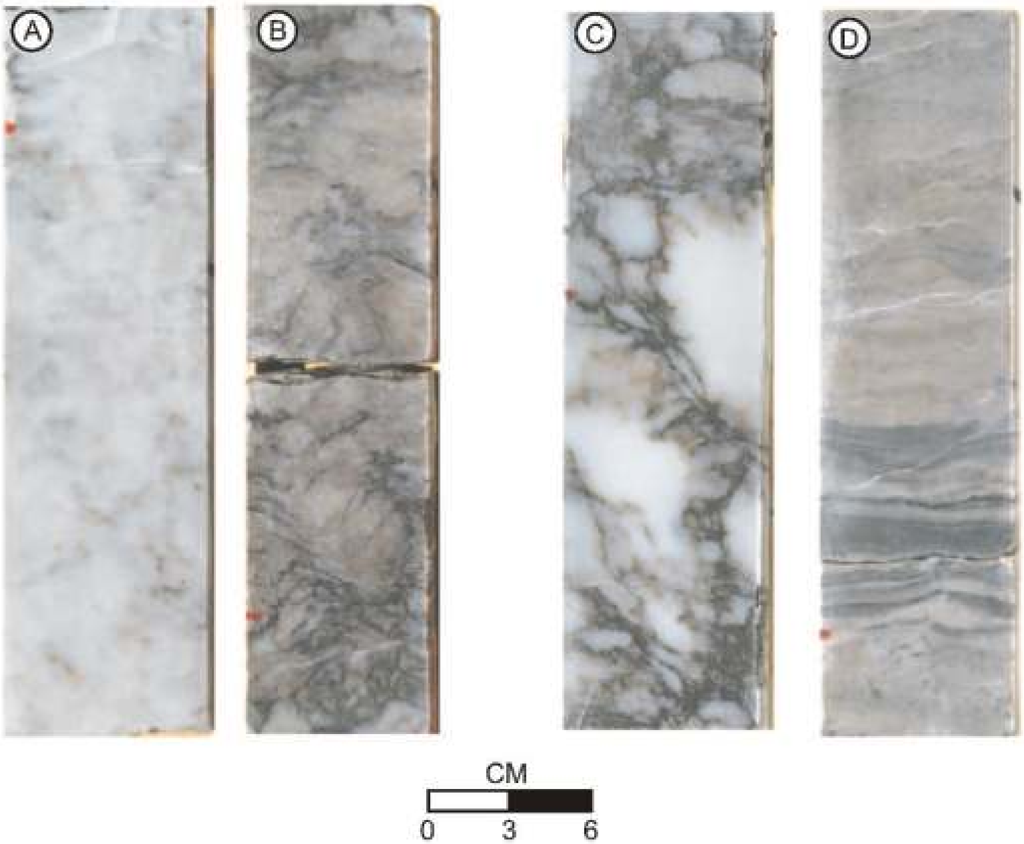

Fig. 3. Examples of anhydrite classification types within the "Anhydrite" group (>75% anhydrite at roughly the metre-scale)

A – non-distinct massive anhydrite; no distinct anhydrite mass morphology can be readily identified in this example; **B** – pseudo-crystalline mosaic anhydrite; anhydrite in this case is pseudomorphic after selenitic gypsum; former swallow-tail morphology can be clearly identified in the base of the core sample; **C** – pseudo-nodular mosaic anhydrite; nodules can be readily identified, each being enveloped in a thin sediment envelope; **D** – stratigraphic layered anhydrite; layers of darker and lighter anhydrite are readily observed, and may relate to cyclic evaporation/recharge events at the time of deposition; samples come from various Mesozoic cores in the middle east and gulf of Mexico regions

a metre-scale anhydrite body that either lacks any visible internal structure, or lacks any matrix sediment or sediment sheaths between anhydrite masses. Typically massive anhydrite can be further subdivided into morphologies that have either completely non-distinct fabric (non-distinct), or contain ghost pseudo-crystals (pseudo-crystalline). The second morphological group common to anhydrite-dominated sediment is the mosaic. Mosaic anhydrite is defined here as anhydrite with visible internal structure with thin sediment sheaths or envelopes, separating anhydrite masses. Anhydrite mass morphology can usually be determined, and can be subdivided into those that are pseudo crystalline (again typically after gypsum) or more commonly pseudo nodular in morphology. A common example of pseudo-nodular mosaic anhydrite would be the classic "chicken wire" anhydrite, where a seemingly fitted fabric of compressed nodules are separated by mm-thick sediment sheaths. Finally, a third morphological subdivision of the anhydrite group, ain layered anhydrite is identified as a common form in anhydrite-dominated sediments. Layered anhydrite typically has horizontal to subhorizontal layers (typically centimetre-scale individual layers) that define the fabric of the succession. Layered anhydrite can be separated into that which is roughly parallel to adjacent stratigraphy and that which is otherwise disrupted or diapiric.

The majority of interpretations found in literature surrounding the genetic relationship between thick, bedded, anhydrite-dominated fabrics and their formative environments are that these fabrics are indicative of deposition in subaqueous salina-type settings. That is, gypsum would have been precipitated in standing water, and later converted to anhydrite in the diagenetic realm. That being said, any interpretation of this type needs to be accompanied by additional data, such as the presence of other deposits associated with deposition from standing water (large vertically-oriented gypsum crystals, varve-type layering, *etc*.).

ANHYDRITIC "MATRIX" GROUP

Within metre-scale successions where anhydrite is not the dominant lithology, the classification group is "Anhydritic matrix". In practice, the term "matrix" would be replaced with a descriptive term for the host rock (e.g., Dunham classification for carbonates). As with the anhydrite group, multiple sub-categories may be recognized within the anhydritic matrix group allowing for further classification subdivisions. Anhydritic matrix morphologies have been put into 4 groups: pore/void-filling, nodular, crystallotopic and layered.

Pore/void filling anhydrite is that anhydrite that is visibly filling former void space. Any number of void names (e.g., vug, mould, fracture, burrow, *etc.*) are intended to be substituted for the term "void" in practice, such that these subdivisions may be described while remaining within the context of the classification scheme. As an example, a void-filling anhydritic matrix fabric that fills burrows in a dolowackstone would be termed burrow-filling anhydritic dolowackestone, while a void-filling anhydritic matrix fabric that fills moulds in a skeletal grainstone would be termed a mould-filling anhydritic skeletal grainstone.

Nodular anhydrite is the second subgroup of the anhydritic matrix category, and is described as anhydrite that forms either solitary or coalesced sub-spherical nodules within host sediment. Anhydrite of this type is found in modern sabkhas and many times serves as an indicator of sabkha-like environmental conditions when identified in the ancient, where it would have presumably grown as displacive bodies within the upper 10s of cm of sediment. Evidence for the displacive growth often comes from petrographic examination and identification of deformed "felted" microcrystals around the rim of the anhydrite mass.

Crystallotopic anhydrite is also commonly recognized in rocks formed in evaporative settings and forms the third subgroup within the anhydritic matrix category. Crystallotopic anhydrite is that anhydrite which retains the shape of a crystal-in many cases being a pseudomorph after gypsum. These crystals may be in-place pseudomorphs, or may be disrupted or broken by any number of processes (e.g., re-working and transport of gypsum laths in storm beds). Again, confirmation of crystal form through petrographic examination is often necessary.

Layered anhydrite can also be found in beds not dominated by anhydrite, its description being similar to that in anhydrite-dominated successions. Examples of these types of anhydrite can be seen in Figure 4.

The categories of anhydrite described above have been summarized in a flow-chart for ease of classification. The chart reads from left to right following a simple observation-based descriptive scheme. The first decision that needs to be made by the user is whether or not anhydrite is the dominant mineralogy (*ca*. 75%+) at the metre-scale. If anhydrite is the dominant mineralogy, the interval would be classified within the anhydrite

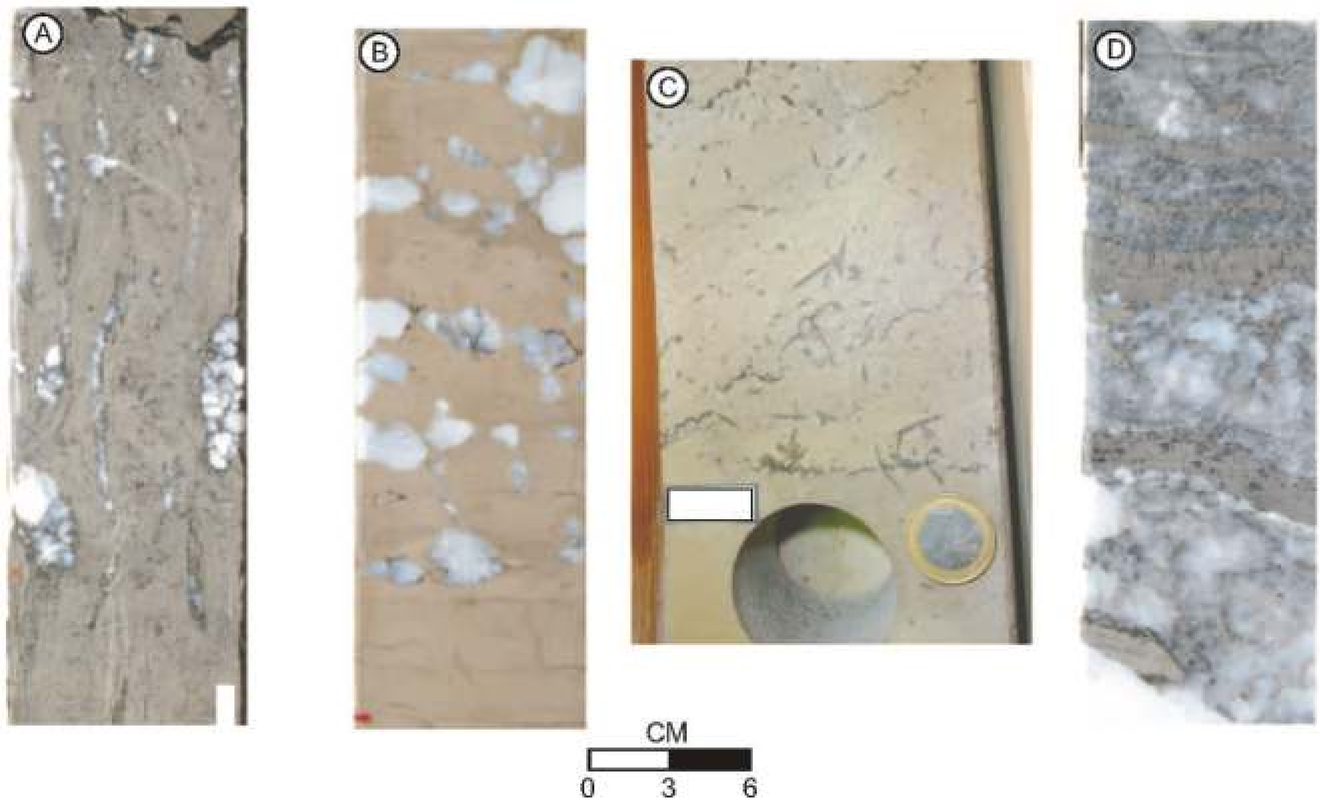

Fig. 4. Examples of anhydrite classification types within the "Anhydritic matrix" group (host sediment > anhydrite at roughly the metre-scale)

A – burrow-filling anhydritic dolopackstone; in this example, anhydrite has filled former burrow traces; **B** – solitary nodular anhydritic dolowackestone; anhydrite nodules are clearly visible and form individual masses that are volumetrically subordinate to the host sediment; **C** – disrupted pseudomorphic crystallotopic anhydritic dolograinstone; in this case, anhydrite is pseudomorphic after lenticular gypsum crystals; many of the crystals identified in this cross bedded dolograinstone are broken, evidence that they were transported (disrupted from their original position) along with the host sediment grains by fluid energy; **D** – stratigraphic layered anhydritic dolowackestone; anhydrite in this example forms layers within dolowackestone that are parallel to sub-parallel to stratigraphy; samples come from various Mesozoic cores in the middle east and gulf of Mexico regions group, and if not would be classified within the anhydritic matrix group. The user then needs to determine what the primary fabric of the anhydrite in question is (based on the descriptions of each given above), and finally the subgroup of that fabric. Once that has been determined, the user classifies the anhydrite by name using:

a – the anhydrite fabric subgroup name,

b – the anhydrite fabric name,

c – the anhydrite group name,

d – the descriptive name of the host sediment (if the sample is in the anhydritic matrix subgroup; refer to Figure 2).

Following the chart based on the volume of anhydrite present in a given sample will yield a name based on observations that gives both a morphological description, a proportion of anhydrite to host sediment, and when anhydrite is the non-dominant mineralogy, the type of sediment within which it is found.

THE UTILITY OF THE ANHYDRITE CLASSIFICATION SYSTEM – STRATIGRAPHIC PREDICTION

Any sort of robust, reliable method for determining and/or mapping anhydrite distribution in the subsurface would be a welcome part of any subsurface study in which anhydrite occurrence affects reservoir quality. Differentiation of evaporative sub-environments can be aided through the classification, interpretation, and mapping of anhydrite types and associated facies associations. To that end, having a classification system for anhydrite that contains information about morphology, percentage of anhydrite within a rock volume, and information about the sediment that contains the anhydrite becomes important for differentiating depositional settings, palaeoenvironments, and both vertical and lateral trends in anhydrite occurrence. Classification of anhydrite in relation to host sediment is an important step in differentiating anhydrite types for the understanding of facies distributions and reconstruction of environments through time.

Anhydrite classification systems to date have focused primarily on morphology. In addition, studies that have attempted to link particular anhydrite morphologies and related facies succession to formative process have not utilized a published classification system for anhydrite. This system represents an attempt to close this loop. This system takes into account bulk anhydrite volume, which can in some instances be related to depositional process, observed morphology, as well as a brief description of the host sediment within which the anhydrite is found. Including all of these elements into one name provides for more useful information to be communicated than by simply classifying according to morphology.

Author's note. The author wishes to invite the wider scientific community to make suggestions for changes and/or improvements to the classification scheme. This submission is intended to be a new attempt to arrive at a more widely-used system for classification of anhydrite rather than the final answer to the anhydrite classification question. The intention is also to have a system that integrates well with currently used descriptive schemes. Any suggestions for improvement are welcome and appreciated.

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